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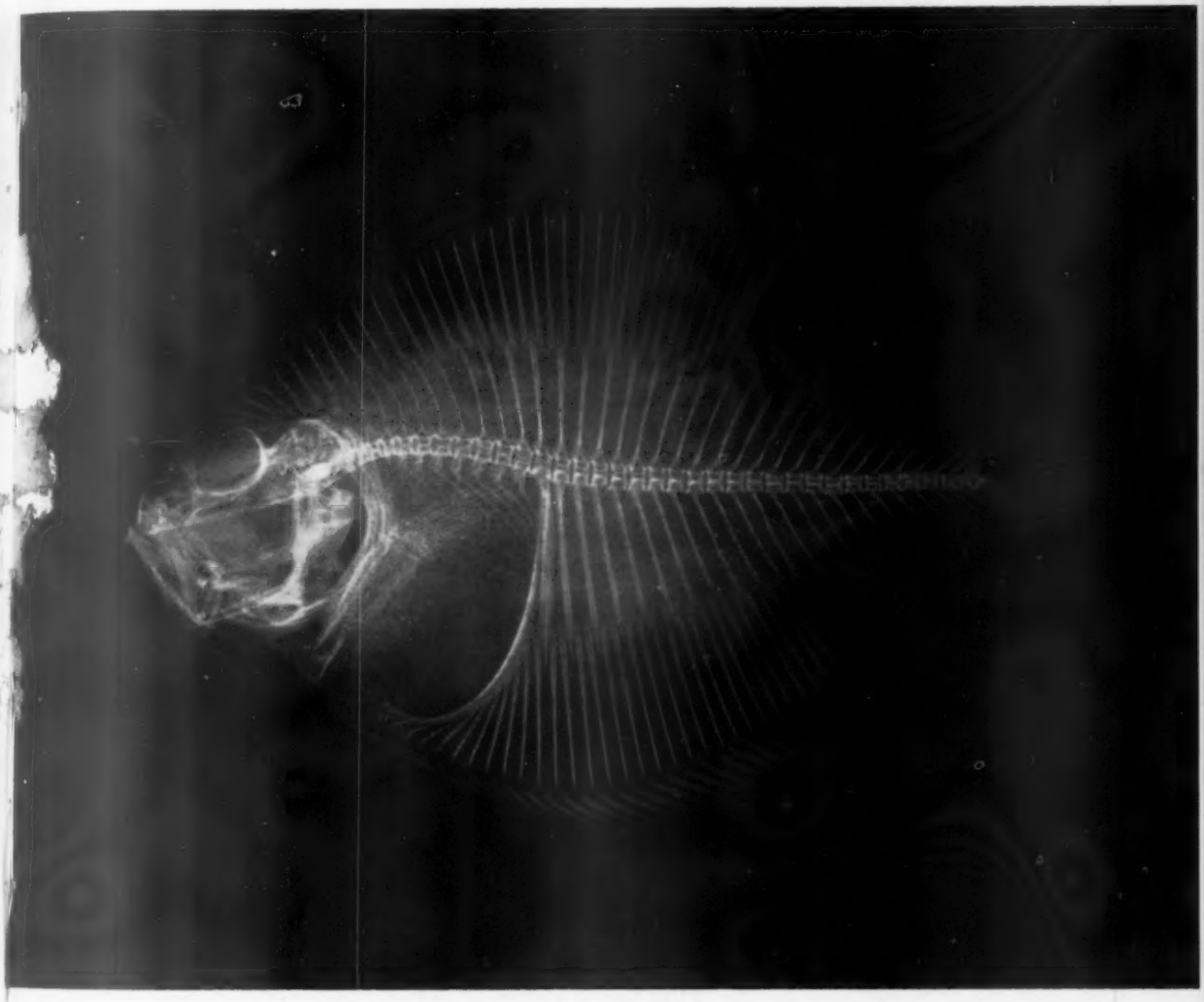
The American Biology Teacher

DECEMBER, 1960 VOLUME 22, NO. 9



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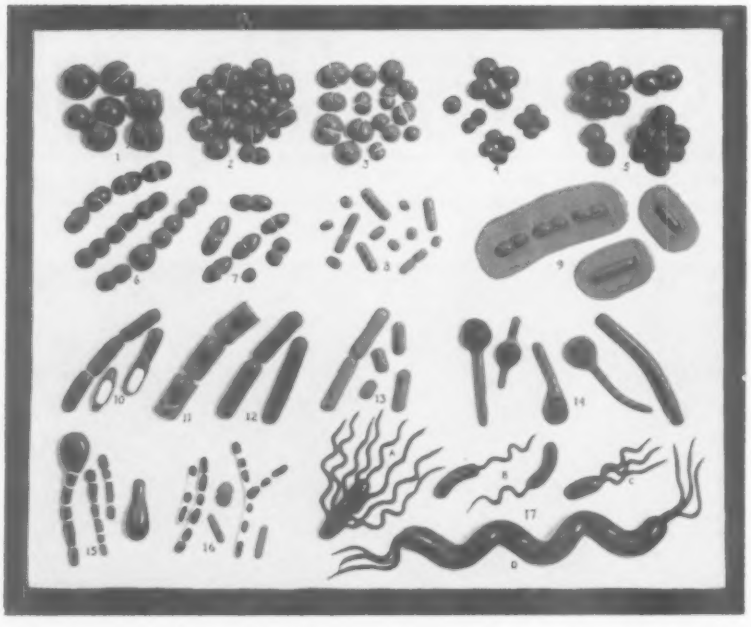

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This picture accompanies an article by David W. Engel carried elsewhere in this issue. It illustrates beautifully and in an unusual way the skeletal system of a fish.

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Elementary School Biology via Television

CHARLES WALCOTT

Massachusetts Audubon Society, South Great Road, South Lincoln, Massachusetts

The birth of a bat, a snake hatching from its egg, a baby deer nursing from its mother, bull moose fighting, or the fertilization of an egg—these are a few of the natural dramas that have been watched by 4th, 5th, and 6th grade students in the New England area last fall. To see these things the children didn't have to leave their classroom or desert their teacher for all these adventures were part of "Exploring Nature," an experimental television program. This series of 30 half-hour programs was produced by the Natural Science Television Project, an organization composed of the Children's Museum of Boston, the Massachusetts Audubon Society, and "The 21" Classroom" of WGHB-TV. Funds were provided by the member organizations and also by a study grant made available to the School of Education of Boston University through the U. S. Office of Education in connection with a study of the educational results of the project. The programs themselves were produced under the supervision of the Education Department of the Massachusetts Audubon Society.

The aim of the project was to teach elementary school students the principles of biology. Such principles as the flow of energy in the organism and in the community, evolution, animal behavior, and the structure and function of living organisms were stressed throughout all the programs. The television programs generally dealt with a single topic, but each program was related both to the ones that preceded and followed it. This gave the student a chance to continually review the material already presented and thereby get a unified picture of biology.

The television teacher was Prof. William H. Weston. A Harvard professor of many years' standing, he continues to enliven the teaching of biology and to share his enthusiasm with young and old alike. By making extensive use of live animals and plants, film, special art work, carefully designed props, and other materials, "Cap" Weston was able to keep the children interested in the subject without resorting to gimmicks such as may be found on some commercial programs. It would be disastrous if the programs were dull, but fortunately live material, being unpredictable, is never dull; by using it and much other visual material, the student's interest was tightly held.

The television program was only a portion of the project. The other important part was the teaching that went on in the classroom both before and after the broadcast, and for this reason the success or failure of the project rested mainly on the classroom teacher. It was her job to prepare her class before each televised lesson and to follow up afterward.

To aid her in this, a detailed Teacher's Guide was prepared. This is an 140-page illustrated booklet that contains a summary of the background material on each topic and is designed for the teacher not familiar with biology. It also contains a summary of the television program itself, a series of questions for class discussion, a list of the important new words used in the lesson, and two book lists—one for the teacher and another for the student. By using this Guide a teacher who is completely unfamiliar with biology can effectively prepare the class for the television lesson and also follow up. But the follow-up does not end with a class discussion of the program. The Teacher's Guide also suggests simple projects for the student and gives complete instructions on how to do them. In addition, for use by the student, we have prepared "Student Guides." These are four-page leaflets describing simple projects easily performed with equipment available around any house. It is our hope that, for a student in a class severely limited in the time available for science instruction, the project sheets may increase his understanding of the material, showing him how he himself may demonstrate the principles discussed on television.

All this preparation required a great deal of work by many people. The production and broadcast of the television program alone required the services of 23 people at WGBH-

TV. The Teacher's Guide was prepared by a committee of Audubon teachers and edited by Drs. Drury, Meyerriecks, Weston, and Walcott. The Student Guides were written and the experiments designed and tested by Mrs. P. J. Darlington; the illustrations and layout were by Polly Shakespeare. I was the producer of the Television Program and Edmund Cabot was the Assistant Producer. The art was done by our artist, Betty Sears, and film was taken by Peter Ourusoff, Benjamin Walcott, and the rest of the crew. The staff of WGBH-TV, Channel 2 in Boston, broadcasted the program.

The general sequence of the program topics and the concepts to be covered in each were outlined last spring by Professor Weston working with a group of teachers from the Massachusetts Audubon Society teaching staff. On Monday of each week, therefore, Ned, Cap, and I held a production conference at which we went over this material and tried to determine the most effective way of getting it across to our audience. This was not the first time that we had considered the problem, however. During the summer we had all been busy taking film sequences to illustrate important points, and in the weeks before the Monday production meeting we had been busy obtaining film material from other photographers and gathering additional material. On this Monday we went over the concepts to be covered, and Cap, Ned, and myself, with the advice of the Audubon teaching staff, decided how the material was to be presented, what visual material was to be used, what the studio

Professor Lyman of Harvard, our guest, takes the heartbeat of a ground squirrel.

The star of our show, "Cap" Weston, leans on some very handy guinea pigs.

set-up would be, what vocabulary words would be used as "super slides" (words to be super-imposed over the picture on the TV screen), and all the necessary details of the TV production. Ned took complete notes which he later turned into the program script. Towards the end of the afternoon, Betty Sears, our artist, arrived and we ran over the script with her, suggesting the art work that we thought would be effective and profiting greatly by her experience in presenting ideas visually.

Tuesday was usually spent frantically editing film, preparing the tapes of natural sounds, finishing the script, and making arrangements to obtain the fossil dinosaur footprints, insects in amber, and other objects to be used on the television program. At the end of the day the finished work print of the film we were planning to use was matched to the negative, and the negative was rushed to a commercial laboratory to have a special television print made. The unfortunate thing about using film is the amount of time required for adequate preparation. We found that taking and editing five minutes of film involves the work of one person for three full days. But the use of film allowed us to show so many things that would otherwise be impossible, that we didn't begrudge the time.

On Wednesday, Cap, Ned, and I went over the finished script, making any small changes we felt necessary, and then Cap went over the film. If the film took more than a few minutes he would do his narration then and record it on ¼" magnetic tape. He usually

Betty Sears, our artist, lends much visual pleasure to our Exploring Nature Show.

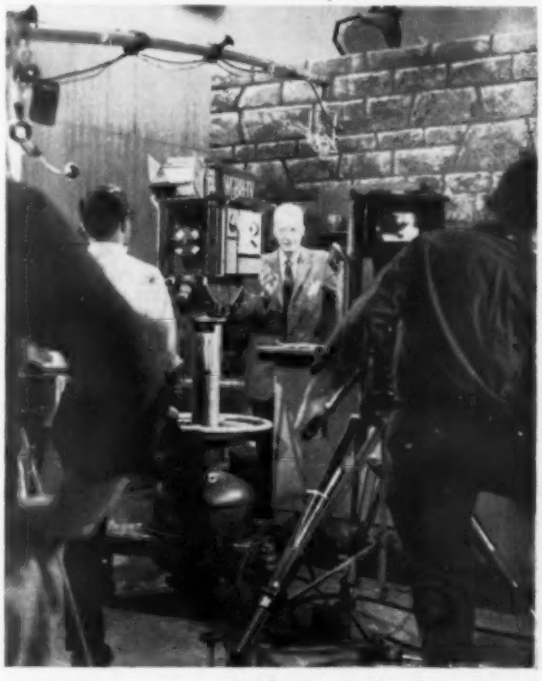
did this two or three times, and we chose the best one of three, edited it where necessary, added sound from our library of natural sound recordings, and finally synchronized the tape to the film.

On Wednesday afternoon a copy of the completed script was taken to the TV director, Jean Brady at WGBH, and we went over the script to see if there were any unusual problems. Jean decided how the set should be arranged, discussed the lighting with Kenny Anderson, our lighting director, and also planned the shots for the camera men.

Thursday was spent gathering materials, perhaps beginning work on next week's film, and generally gathering the props. Late Thursday afternoon all the material to be used on the TV show, including the film, art work, and the necessary items for experiments and demonstrations collected from a multitude of different people around the Boston area, was taken into the studio where Jean and the TV crew worked far into the night arranging the set, art work, and other material.

On Friday began the lengthy task of piecing all the elements of the program together. In the morning we all went over the script, timed portions of it, and made the final decisions as to how we were going to arrange the materials. About noon the set was lit, and at 2:15 the crew had arrived, the cameras were warmed up and rehearsal could begin. Rehearsal lasted until about 3:45, there was a 15-minute break for final adjustments of the lighting, to repair the damage the racoon had done to the scenery, and other last-minute details. Promptly at 4:00 p.m. the video tape machine was started, and for the next 29 minutes and 25 seconds, with a maximum error of 1 second, the program was recorded, an exacting time limit due to the tight schedule of the New England Educational Television Network. Recording the program on video tape was a great advantage. In the event of a major catastrophe it could always be done over. If absolutely necessary, video tape can be edited, and best of all, video tape can be played back an almost unlimited number of times, and each time the quality of the picture and sound is almost indistinguishable from a live telecast.

By Friday night the tired crew had finished; the props and film had been returned to headquarters, and then at 7:00 p.m. the program which was recorded on video tape two weeks before was broadcast. This third and final broadcast had been preceded by two



"Cap" Weston surrounded by hundreds of people and vast amounts of equipment.

morning broadcasts which were used in the schools belonging to "The 21" Classroom." The seven o'clock broadcast was viewed by the general public, as well as by the interested parents of those students who watched the morning broadcast in school. The weekend was then spent filming for future programs and doing the many things that had been neglected during the week.

As can be imagined, the expense of the project was great: the total was near $75,-000.00. The question that we kept asking ourselves was: "Does 'Exploring Nature' help in the learning of biology at the 5th grade level?"

This was the same question being asked by Dr. Garry at Boston University, and presumably in a year or so he should be able to tell. As of the moment we can only report what we know. We do know that there are over 3,000 copies of the Teacher's Guides in the hands of elementary school teachers in Massachusetts, Connecticut, New Hampshire, and Rhode Island. The Student Guides, which were made available to students at our cost, roughly 10¢ for the four issues, have over 11,000 paid subscribers so far, and the TV program is broadcast three times on Friday by WGBH-TV, Channel 2, in Boston and once by WENH, Channel 11, in Durham, New Hampshire.

How do the classroom teachers feel about the project? In response to a questionnaire they are generally most enthusiastic. "They see something work," "The children listen attentively," "are spellbound," "of great help to the teacher," "classroom richer because of experience," "best thing to come into elementary school science in my memory." Professor Weston was: "pleasing to listen to," "holds the child's interest," was "liked by children," "highly conducive to enjoyment and understanding and his enthusiasm reflects in the children." On the other hand, some teachers have reservations: "Professor Weston uses too many long words"; "he tends to lose the children's interest by a monotonous style." Probably the most encouraging comments about the series come from the children's own letters—the fifth grader who wrote: "We had no school today, but I watched the program three times. The 'birth of a bat' was swell." What more can we ask?

The program, then, seems to have accomplished some of our aims. As far as we can tell, the children found it interesting, and if we can judge by their letters, they learned a great deal. Furthermore, because the television programs are recorded on video tape, they will be available next year for use here and also to other TV stations and school systems in other parts of the country. We would be glad to send sample copies of the Student Guides, Teacher's Guides, or a copy of one of the video tapes or kinescopes of the TV programs to anyone who is interested. It would seem that an effort to supplement the teaching of elementary school science with a program of basic biology on television is feasible. What the long-range effect of this sort of project may be, we cannot assess. But, in any event, these helpful criticisms guide us in preparing future programs. It is fair to say that without honest and complete cooperation between the television production staff and the classroom teachers who use the program, this sort of television venture is liable to fail.

Thus, by bringing to life for our young audience some fundamental principles of science, we feel that we have prepared them to better understand, to weigh, to judge, to appreciate, and to interpret the knowledge they will acquire in the future.

FAST Journal

The periodical of the Florida Association of Science Teachers is an interesting development showing what state organizations may do in publications concerning mutual problems involved with science teachers within one area. NABT member and Assistant Editor, J. D. Woolever, Sarasota, Florida, is editor. Professor Clyde Reed, University of Tampa, Florida, a candidate for NABT Regional Director, is Editor Emeritus. The subscription price is $2.00, and inquiries concerning it should be directed to Managing Editor, Dempsey Thomas, 4850 Lords Avenue, Sarasota, Florida.

Biology via Telephone

W. R. ZEITLER*
Ohio State University, Columbus

At last the day arrived when shut-in students could again take part in many regular school activities. Frequently the only school contact a home-bound student had was the visit of the visiting teacher. Through the miracle of the telephone the world of these students was broadened. They were able to participate in class discussions and activities while being confined at home or in the hospital.

All home-bound or hospitalized cases were not suited for the home-to-school telephone instruction. Each case was considered individually on the bases of age, I. Q., type of disability, home situation, and certain psychological factors.

Although there was a great need for research to be done, it was the consensus of opinion of those who have worked with the program that the minimum mental ability level of nine years with a fourth grade achievement level was the lowest level for the maximum benefit from the program. A minimum I. Q. of 90 was suggested. There were cases of successful teaching below this level, but they were not frequent. The program worked successfully with students who had cerebral palsy, fractures, muscular dystrophy, polio, tuberculosis, and cardiac cases. It was generally felt that if a student had the intelligence and can operate the telephone switch, if he can see, talk, read, and write, he could participate in the program. Other factors that influenced the selection of a child were the advice of the physician, the cooperation of the parents, and recommendation of the school guidance counselor.

Before the program of school-to-home telephone instruction began, there was a complete orientation of all those involved. This activity had a great influence upon the success of the program. Each individual involved in any way in the program must be aware of its operation. This necessitated the cooperation and understanding of the child, his parents, the director, the teacher, and the visiting teacher.

After a child was selected for the program, he was acquainted with the possibilities and limitations of telephone instruction. He was told that he would not merely be a listener but that he would be a participant in the class. He was to be responsible for discussion, for questions, and for giving reports. These activities gave him a sense of personal contact with the other members of the class. The students were instructed in the proper use of the equipment and the procedure to follow in case it did not operate properly.

Before instruction began the student was made aware of the type of instruction he was to receive. He knew how the tests could be given, the type of tests that would be used, and the supplies and equipment that were needed. A textbook was furnished him to follow in class. It frequently helped a student if he had a list of assignments. If laboratory work was to be given, he needed instruction on the procedure and methods necessary for him to participate. The telephone student was aware of the method of receiving and returning materials.

The initial orientation of the telephone student was completed with his visit to the classroom and/or the laboratory. In this way he was given a basis for visualizing the class. A photo of the class and/or the laboratory was made for the telephone student. He was able to refer to it when some mention was made of a section of the room. The areas of the rooms were identified by numbers on the photo.

A photo of his classmates was made also and their names were put on this photo. This was another way of bringing the telephone student in closer relation with the class.

The cooperation of the parents was vital to the success of the program. If the child was to benefit from the teaching, his parents must provide an environment that was conducive to study and learning. The operation

*The author formerly taught at Parma High School, Parma, Ohio.

of the program was explained to the parents first. It was most necessary to explain their importance to the success of the program. The parents knew what procedures would be followed and what was expected of their child. If a change in the procedure was necessary, it was discussed with them before it was made.

The preparation of the teacher for school-to-home teaching was extensive. First, the teacher was acquainted with the equipment, its operation, limitations, and possibilities. Representatives of the telephone company were extremely helpful with this matter. The teacher became familiar with the child, his home situation, abilities, and disabilities, interests, and school record. It was very helpful for the teacher to visit the home of the child and meet the child and his parents. Rapport was established in this manner.

Some schools have a director for school-to-home telephone instruction. This person acts as a liaison between the home and school. He frequently takes care of the administrative details of the program.

The visiting teacher worked very closely with the teacher of the class. He knew what the assignments were, what was required, and the types of tests that would be given. He was given a copy of everything that the class teacher sent to the telephone students. He served as the regular home contact for the class teacher. The visiting teacher was also responsible for administering the tests and explaining the work that the student may want explained further.

The class with which the telephone students worked was informed and its cooperation was secured. The members of the class took responsibility for some of the details to make the program more effective. The class generally welcomed the opportunity to help someone less fortunate than they. During the first class each member spoke to the telephone students and gave his name so he could be identified on the photo. A photo of the telephone students was taken and showed to the class. This helped to give a closer relation between the class and the telephone students.

Teaching biology by telephone presented an opportunity for development of new methods and techniques. As time progressed some were developed, others modified, and some discarded. This gave a fresh approach to teaching and generally improved it.

A list of assignments was given to the telephone students at the beginning of each grading period. The assignments were collected weekly from the telephone students, checked, and returned.

The basic method of instruction was lecture. However there were periods of class discussions, questions and answers, and reports. The method varied with the material presented and provided a variety for the class. The discussions were based upon the daily assignments. The reports came from selected books, magazines, and newspapers.

After attendance was checked, the class work began. When there was board work a member of the class described what was written or drawn on the board. Questions were asked frequently during the lecture. This tended to bring the telephone students into closer contact with the class.

During the discussions and reports the class gathered around the desk where the phones were. The telephone students were responsible for discussions and reports the same as the other members of the class. The class tended to come into closer contact with the telephone students during the periods of free discussions in which everyone participated.

Since lecture material frequently was not in the text, the telephone students were asked if they got the notes, and if they understood the material. Examples used during the lecture were of objects with which the telephone students would be familiar. Instead of trying to describe something that may be in the classroom, a drawing was used. There were frequent reviews of lecture material. This was the most practical method of determining whether the telephone students understood the material.

Biology via telephone required extensive use of visual aids. The greatest limitation of the telephone students was their inability to see what was being done in the class room. Visual aids were used to reinforce the lectures and laboratory work. The material was somewhat meaningless without them. The visual aids that were used consisted of actual examples, photos, movies, slides, and drawings. Some of these were sent to the students.

The drawings were made by observing the actual object whenever possible. If the draw-

ing was of cells, the slide of the cells was used as a model. Every attempt was made to be accurate. Colors were used as much as possible on the drawings.

Photos were used extensively. Many photos were taken of the same objects as the drawings. These photos were numbered in the same manner as the drawings.

Special attention was required when movies were used in class. The movies were previewed before class time. Notes were taken upon the important points of the film, and it was noted when the commentator was not speaking. Before the film was shown a brief summary of the film was given. This consisted of a general outline of the ideas, principles and facts that would be presented, the structures that would be shown and other facts that would make the film more meaningful.

The telephones were placed so the sound of the film could be heard. As the film was shown the voice of the commentator was heard by the telephone students. When there was no voice the pictures on the screen were described and any other information that may be necessary was given.

When models were used in class, drawings of these were sent to the students. Illustrations that would be put on the board during the lecture were made on paper and sent also. The same procedure was followed when charts were used.

The most difficult but interesting part of telephone biology was the laboratory work. The type of disability the student had influenced the extent of participation of each telephone student. If the student had coordination of the hands, he probably could participate fully. However, changes for the type of disability were made. This was determined by the teacher before the actual teaching began.

The organization of the laboratory work was the first step in giving meaningful exercises. The laboratory exercises for the year were planned at the beginning of the term. A laboratory direction sheet was printed listing the objectives, the equipment, the procedure, and space for the conclusions. Space was given for sketches if they were needed. The exercises for the first semester consisted basically of microscope work. The work of the second semester consisted largely of dissection.

The first laboratory exercise was to acquaint all students with the laboratory and laboratory rules, and regulations. The photos of the laboratory were used by the telephone students. Although they were not going to attend laboratory during the year, it was desired that they should know what the laboratory was like.

The second exercise was on the microscope. A photo of the student microscope was taken and sent to the telephone students. The parts that they were to know were numbered. Since microscopes could not be sent to the students, the photo was the only method to acquaint the telephone students with the instruments. The students listened while the rest of the class learned the procedure for focusing. There was no method for instructing the telephone student proper procedure for focusing. As a part was mentioned, its number was found on the photo that the telephone students had.

As the members of the class worked, photos were discussed with the telephone students and their questions were answered. They named the numbered parts. Parts or sections that were not numbered were also discussed or described. The major difference between the work of the telephone student and the rest of the class was that the regular class made and focused the slides on the microscope. The telephone students saw that same thing as the regular class and were responsible for the same material. Frequently the class found the photos of great help in its work.

Photos were made of slides of various types of alga cells, monocot, and dicot stems, leaves, roots and flowers, cells in mitotic division, Protozoa, sponges, flatworms, and roundworms, and insects. There were twenty photos in the series.

As the year progressed the telephone students were given greater responsibility for finding the numbered parts on the photos. More discussion of the slides in general was held. Systems, relationship between cellular structure and functions, and the relationship among the various types of plant and animal cells were the major topics for discussion during the laboratory. The telephone student kept the photos until the end of the term.

This permitted a quick review of material previously studied.

Arrangements were made for the telephone students to do dissection with the class. Of course they would do this in their homes. Rather detailed instructions were written for these students. An explanation of the procedure was given during a home visit. The students were informed of the material that they were to provide. To reinforce this an explanation of the complete procedure was given by telephone and all questions answered. Specimens were put into individual containers and sent to the students. They received dissecting instruments, drawings of the animals, and instruction sheets. There were many opportunities for the telephone students to ask questions about procedures before they were ready to dissect. When they were ready to begin their work, they had a drawing showing the exterior and interior of the animal. The drawing has lines marked on it showing the places to cut.

The greatest problem for the telephone student was finding the correct places to cut. Locations were given in terms of ventral, dorsal, posterior, anterior, lateral, and median. The drawings helped overcome this also. This problem solved itself with practice. After the animal was opened, it was an easy task to find the internal structures. Numbered flags were used to identify the parts.

The instructor talked with the telephone students at length. He followed the students as they dissected and answered questions as the need arose. This attention was given to each structure or area that the students were to find. In a short time the telephone students were dissecting as rapidly as the others, and the quality of dissection was excellent.

When the students had completed their dissections, they returned the animals to school for checking. After it was checked, the visiting teacher would point out the mistakes on an animal that was properly dissected. However, there were few mistakes in dissection.

The class in the laboratory benefitted from hearing the description of location given to the telephone students. The time that was given to the class in the laboratory was about three-quarters of the period and the telephone students required about one-quarter of the period. In a short time the telephone students were dissecting as rapidly as the others in the class.

The adjustment that was required in the teaching time during laboratory was minor after the telephone students were accustomed to this type of work. The telephone students progressed as rapidly and were able to do the same quality of work as the others in the class.

When the telephone students began class, it was determined that they would be responsible for the same basic work and testing program as any member of the regular class. The testing program consisted of daily quizzes, chapter tests, unit tests, and laboratory practical tests. Of necessity the telephone students were put on the honor system for some of the tests.

Daily quizzes consisted of five questions given at the beginning of each class period. The class wrote the answers, and they were corrected in class. After the papers were graded, the grades were recorded. The telephone students corrected their own papers and reported their scores.

While the class was taking the chapter and unit tests, the telephone was disconnected. The telephone students were given these tests by the visiting teacher during his weekly visit. These tests consisted of essay questions which did not lend themselves to administration over the telephone.

The laboratory practical tests were administered during the laboratory period. The questions consisted of identification of structures and cells, comparison of structures, and their arrangement. The telephone students were asked questions that could be answered by study of the photos. This type of test was easy to administer.

When the students were dissecting, quizzes were given on identification of structures. The telephone students marked the structures with pin flags and sent the animal to school for checking. The visiting teacher took a properly dissected animal and pointed out the errors. This procedure was not needed after the second animal was dissected.

The measurement of the success of the entire program of telephone teaching was based upon the test results. These results were compared favorably with the results of the regular classes. Lack of time prevented further testing to obtain a more accurate

result. The students who participated in the program felt that they gained a great deal from this type of program.

Although no program could take the place of regular class attendance, the school-to-home telephone made it possible for the shut-in students to be a part of the group again. He had some sense of being a part of the class and that he belonged. He had the experience of participation in class activities, although it was limited.

There are some modifications that could have been made in the method of presentation, but experience was necessary to make a teacher aware of these. The basic concepts served the purpose adequately, however. The same type of work that the regular class did was expected of the telephone students. They were required to do the same type of laboratory work as the others in the class. Projects were required of them also.

The program as a whole was a success; however it could not take the place of being in school. It served only as a substitute measure until the child could return to the classroom.

On Using Life Magazine's: Darwin's World of Nature

JACK FISHLEDER
West High School, Phoenix, Arizona

Our use of the series of articles on "Darwin's World of Nature" in *LIFE* magazine may be of interest to some of you. As each issue comes to the newstands, my students bring in copies of the magazine for extra credit. From five classes in biology about forty copies are brought in. Student dispensers restaple the article, discarding the rest of the magazine. Class time is then given, in each class, to reading, or at least looking over the material, and answering questions on teacher-devised guide sheets.

A sampling of the guide sheet on the January 26, 1959, issue included such questions as:

a. What is meant by "archaic fauna"?
b. What example of the "evolutionary principle of convergence" is given in the article?
c. If Darwin made mistakes, does that mean the theory of evolution was wrong? Explain.
d. Among the mammals, which group was more successful than others? What is meant, here, by "more successful"?
e. How did the huge size of the "carnivorous birds" act as a disadvantage to them?
f. Did only the ferocious animals survive? Illustrate.
g. What is so important about the five tons of bones recently found in Argentina?
h. Why did Darwin not mention dinosaurs in his writings?
i. What reason did Darwin give for difficulty of explaining the rise of mammals?
j. From your reading and discussion on this topic, what do *you* think might be some of the changes in structure of man which may occur in millions of years ahead?

Figure 1. Bulletin board arrangement.

Meanwhile the bulletin board has been arranged with the kind of display illustrated in Figure 1. The pages of the magazine have been mounted and trimmed by a student in

Figure 2. Students using *LIFE* in the biology class.

our Visual Aids Department. The titles also have been done by a student in that department. The articles easily lend themselves to all kinds of interesting arrangements.

Each class set of these articles will be saved for use by next year's classes and in future school years. If *LIFE* editors repeat what they have done in the past, supplementary filmstrips will be issued.

During this school year, I have been able to make up full sets and to devise guide questions for:

"The Fantastic Galapagos," Sept. 8, 1958
"Rainbow Realm of Tropical Insects," Nov. 3, 1958
"Strange Creatures of a Lost World," Jan. 26, 1959
"The Animal Heirs of Ages Past," March 26, 1959

I do not mean to imply that this is an original approach, but it is one that I have found to be worth the time and effort. This kind of "free" classroom material is an important part of my course. In its own way, it helps to remind students that the principle of evolution is the basic foundation of a modern biology course.

Teaching Genetics with a Flannel Board

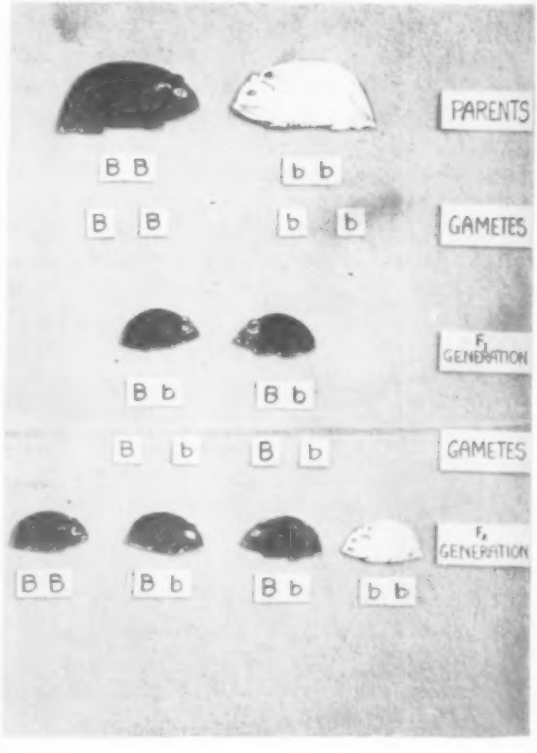
EDNA MAKI KNISKERN
Buzzard Laboratory School, Eastern Illinois University, Charleston, Illinois

The flannel board has long been a favorite teaching aid of teachers in the primary grades, and for the most part, its use has been limited to very young pupils. I have, however, found it to be invaluable in the teaching of genetics in high school and even in beginning biology classes in college.

Flannel boards can be purchased, or easily constructed by covering a piece of masonite or similar material of the desired size with ordinary flannel. Figures cut out of a special flock-backed paper will adhere to the flannel covered surface when applied with a slight amount of pressure. Other materials, such as construction paper and various fabrics, will also adhere readily.

I have prepared several sets of figures which I use in teaching genetics. A few of these are listed below:

Monohybrid cross between a black and white guinea pig
Mendel's experiment with seed color in peas
Incomplete dominance in color in Shorthorn cattle



In each case, the cut-outs of the plants or animals involved in the problem are colored appropriately, and in this way they illustrate vividly what is meant by the term *phenotype*. Under each figure can be placed the proper symbol to illustrate the *genotype*.

Symbols, of course, can mean what it is agreed to have them mean, and various authors and teachers use different systems. In my classes, I use the system wherein the dominant hereditary trait, or its gene, is represented by the capitalized first letter of the word that designates that trait, as B for black, dominant; and that same letter uncapitalized, is used for the recessive allelomorph, as b for white, recessive.

For each set of figures, therefore, I have prepared a group of squares of paper, some of which are marked with the capital letter of the dominant trait which is to be illustrated and others with the uncapitalized letter to designate the recessive trait. In the case of incomplete dominance, or blending, I find it works well to use the initial letter of each of the traits being considered since neither is dominant, as R for red and W for white in the case of color in Shorthorn cattle.

To show how the cut-outs may be used, let us consider the monohybrid cross between a pure black and a pure white guinea pig. As the meaning of "pure line" is being explained, the teacher can place two cut-outs upon the flannel board, one of a black guinea pig, and one of a white guinea pig. Under the black one should then be placed two capital B's with the margins adjacent, and under the white guinea pig should be placed two lower case b's, also with margins touching. These letters would designate the genotype of each of the animals. A label, Parents, or P_1, should be placed near the figures. From the accompanying photograph, it can easily be discerned how the problem can be completed with the use of the rest of the figures and labels whch make up the "set."

My experience has been that talking through a problem, with the use of the cut-out figures on the flannel board, has made the use of symbols clear to many students who have otherwise had difficulty in grasping the concept. Furthermore, permitting the student to think through a problem as he manipulates the figures himself has often "turned on the light" as far as the understanding of genetics is concerned.

Future Scientists of America

The NSTA has created a new organization known as Future Scientists of America (FSA). This project will function as an extracurricular student activity, and membership in FSA is open to all secondary schools throughout the United States. FSA seeks to cooperate with all existing youth programs such as State Junior Academies of Science, Talent Searches, Summer Institutes for students, and similar endeavors. FSA will be unique in that it is the only science youth group administered and designed by science teachers and science educators. It will operate in sending pertinent materials to local chapters.

The Quarterly Newsletter, *The FSA Centrifuge*, will be a publication of the group. Also under their project will be the publication of a series of paperback books under the general title of "Vistas of Science."

The currently operating program of Science Achievement Awards for students will become a part of the FSA program. Mr. William P. Ladson, formerly science department head at Groveton High School, Fairfax County, Virginia, will be director of youth activities under this program.

Rhode Island Plans Oceanarium

A combination aquarium, marine-land, and Museum-of-the-Sea, will open in 1961 in the west shore area of Narragansett Bay near Saunderstown. The proposed construction and opening of this new Rhode Island attraction was announced by the recently formed Rhode Island Oceanarium, Inc., a nonprofit organization interested in the development of the state's natural resources. The Rhode Island Oceanarium will have its serious side, for included in its plans is a research laboratory for the use of students and marine biologists.

A Picture File of Student Projects in Biology

B. JOHN SYROCKI and CHARLES S. THOMAS
State University College of Education, Brockport, New York

Although there are a number of ways to help students with their selection of projects, the use of a picture file of student activities may be your answer. Students respond favorably to working on projects that are correlated with classroom lecture-demonstrations. Implications of the findings of recent research in science education by Whitaker[1] suggest that teachers do deserve straightforward suggestions in aspects of science teaching with added incentives to try out such recommendations. Busy students too need such concrete help as will assist them to participate actively in the instruction.

Anselm[2] defines a project as a useful student activity for purposes of attaining a definite objective. The need arises when students find it necessary in their class participation to demonstrate graphically and/or portray graphically some aspect of the technical knowledge that they have gained. This knowledge may be considered important enough to relate it to others.

Correlating Projects with Classroom Instruction

Projects as supplements to the actual classroom instruction have always intrigued students as well as teachers. Projects which are directly correlated with the sequence of topics covered in class study lend both continuity and stimulation to classroom activity. It is by doing special projects that students get an opportunity to display their manipulative skills and become acquainted with the use of materials, equipment, and possibly tools.

Projects are selected only after careful teacher-pupil planning. The class benefits from a particular project by the visual interpretation of the concepts involved. The student who engages in the project benefits from the first-hand experience, for concepts need to be clearly conceived in carrying out the project.

Students also enjoy the status that their project may give them. Unique ways of presenting facts, results of committee findings, summary points, and possible motivation toward a new area of study can result from interesting student activities.

The Picture File of Activities

Students may respond most favorably to the suggestion of projects in relation to current classroom instruction. However, some students will find themselves in need of concrete help as to what can actually be done. Students may not be aware of the actual techniques of organizing a display, but are still most anxious to get started. They need to be oriented as to the possibilities in using the bulletin board, models (clay, plastic, plaster), dioramas, exhibits, charts, and mockups. Perhaps this is where the picture file of activities related to the instruction contemplated may be most helpful.

The picture file consists of photographs of student activities—their charts, exhibits, and other evidences of their participation. Students can gain good hints as to what can be done. The picture file helps to orient students as to the type of techniques that may be used in presenting the project. It was found that

Figure 1.

[1]Whitaker, Prevo, "Implications of the Findings of Recent Research in Secondary School Science Education," *School Science and Mathematics*," Vol. LVIII, No. 514, November, 1958, pp. 619-623.

[2]Anselm, Brother I., "Making Projects Serve Our Individual Need," *The Science Teacher*, Vol. XXII, No. 5, October, 1955, pp. 228-230.

students generally improve and improvise on existing techniques rather than just accept what they see in the picture file.

Snapping the Pictures

A 35 mm. camera with flash attachment can be used to take the pictures. The 35 mm. size offers economy and ease of operation and will usually provide sufficient sharpness to produce good 5 x 7 enlargements. Slow, fine-grained films should be used since it is often necessary to come close to the objects to be photographed. Using slow films makes it possible to control the amount of light entering the camera by having the opportunity to regulate the lens opening. Films used may include: (a) Kodak Panatomic X, *used at an ASA rating of 50*, and developed in Microdol at 68°F. for 11 minutes, and (b) Adox 14, *used at an ASA rating of 40*, and developed in Rodinal used in the dilution of 1 part developer to 100 parts of water at 68°F. for 15 minutes.

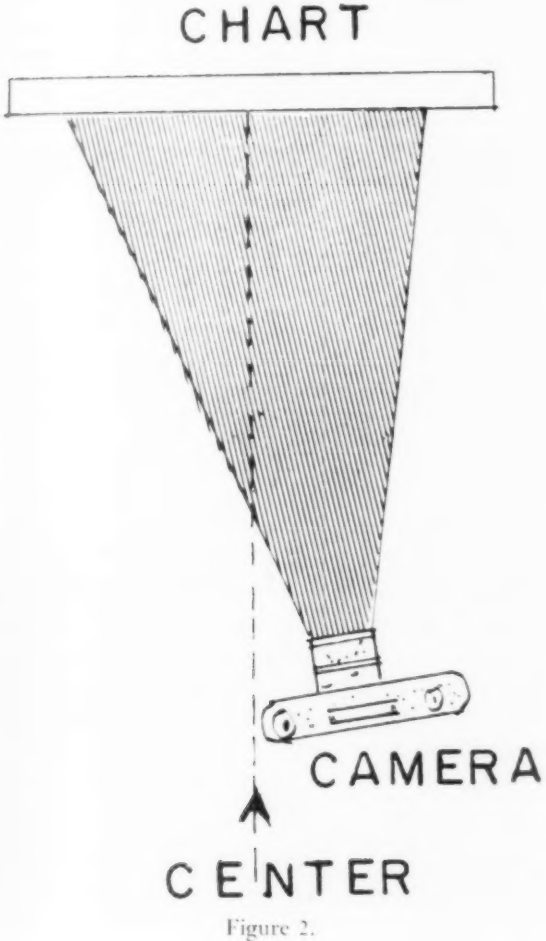


Figure 2.

Figure 3.

In taking the pictures with flash bulbs it is usually best to take the picture at a slight angle as shown in Figure 2. This is especially true when trying to avoid reflections from smooth, shiny surfaces.

It is true that the photograph will appear as though taken from one side. This may be corrected during the enlarging process. The enlarging easel may be tilted sufficiently to counteract the unequal proportion of both sides of the photograph. The finished photographs will appear without major signs of distortion. Some pictures, even though taken at a slight angle, may be perfectly satisfactory.

Preparing the Photographs

Sheets of 8 x 10 single weight, Kodabromide F-3 and F-4 enlarging paper are cut crosswise so that each sheet will yield two pieces 5 x 8 inches. The *picture* size of each enlargement will actually be 4½ x 6½ inches on 5 x 8 paper. In making the enlargement, make sure that the picture is to the right of the 5 x 8 so that part of the unexposed paper is to the left as you view the picture.

Note now that the photograph has a clear area of 1½ inches at one end. Holes are punched in the clear area to allow the photographs to be inserted into a looseleaf notebook.

Photographs from Colored Slides

Pictures can also be made of slides of activities taken in color. Colored slides are projected on a piece of white cardboard 24 x 28 inches. Set up the camera and projector as shown in Figure 4. Be sure that the cardboard has a flat, matte surface, otherwise there

will be too much glare from its surface. The camera is set up on a tripod. This will not only steady your camera but will keep the camera in proper position for the next picture. In this way you can take pictures in a matter of moments.

The camera is set up slightly to one side of the slide projector. Use a projector with a 500-watt bulb and fill the screen about two-thirds full of picture. The camera is about four feet away from the screen. Using Panatomic X, expose 1/10th of a second at a lens opening of f/5.6, or at 1/5th of a second at f/8. Using Adox 14, expose at 1/10th of a second at f/5, or 1/5th of a second at f/7. The exposure recommendation assumes that no additional source of light falls on the screen.

Should the colored slide be slightly underexposed, recheck the brightness of your picture on the screen to set the lens properly. Use the reflected-light method by holding your exposure meter 18 inches away from the screen and *at the same angle* that your camera will take the picture.

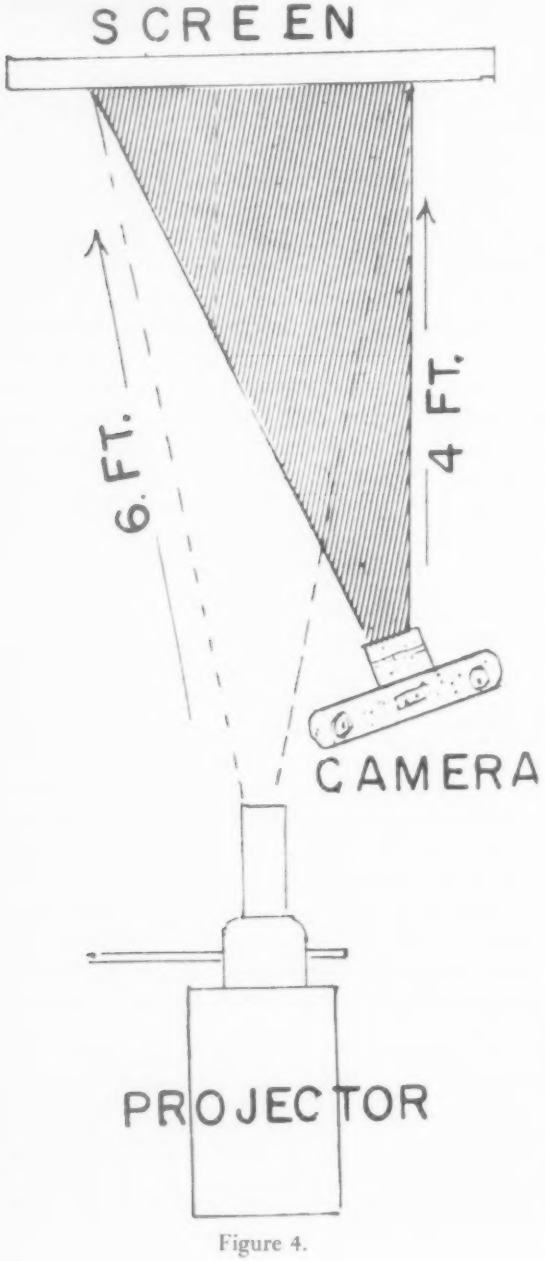


Figure 4.

Leukemia

A chemical that has prolonged the lives of leukemic mice by 150 per cent was described by Dr. Koert Gerzon, research chemist of Eli Lilly and Company, Indianapolis, Ind. Leukemia is a disease involving the uncontrolled multiplication of the white blood cells. The chemical is diepoxybipiperidyl, and its effectiveness against chronic mouse leukemia is about ten times as great as that of diepoxypiperazine, a related compound synthesized at the Lilly Laboratories three years ago, the chemist said. He added, however, that there are indications that the new drug may be more toxic to mice.

Clinical trials of the parent compound at the Sloan-Kettering Institute for Cancer Research in New York City have demonstrated that it can temporarily improve the condition of chronic leukemia patients. Clinical trials of the new compound are now under way.

AIBS Visiting Lectureship Program

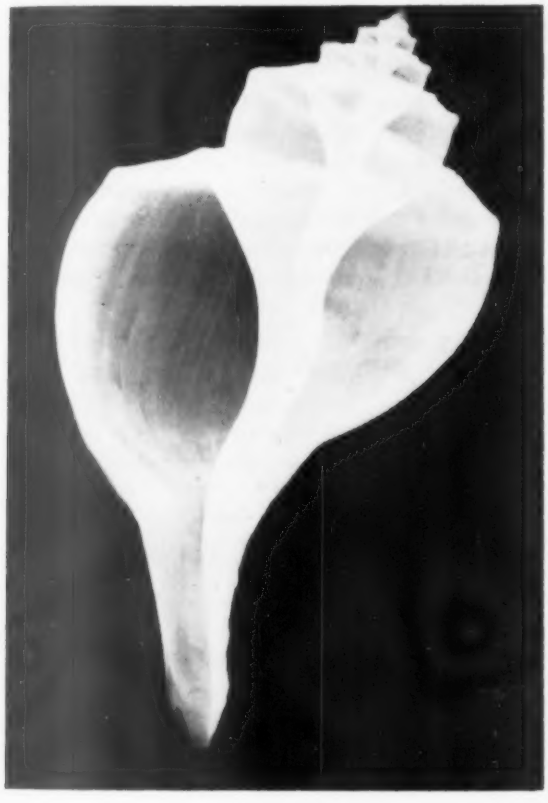
The AIBS has announced a renewal of two of its programs which make available biologists for travel to secondary school and college campuses. Detailed announcements of the available lecturers in the college program are available from Mrs. Mary Louise Blakely, AIBS, 2000 P Street, N.W., Washington 6, D.C. Announcements of the high school program are available from Miss Gloria Crocker at the same address. There is no cost to the schools involved.

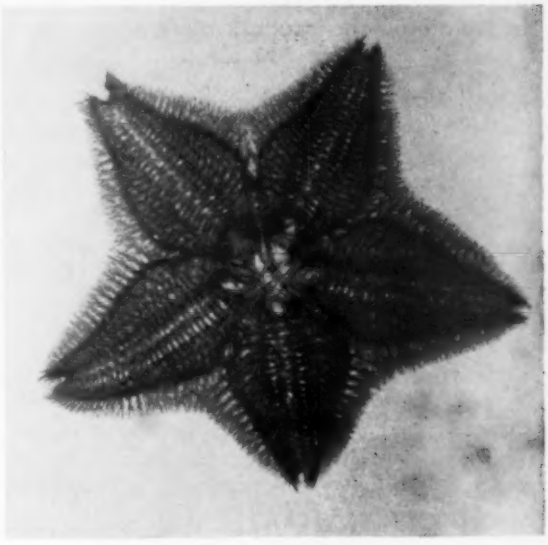
X-Radiography of Marine Animals

DAVID W. ENGEL, *Duke Marine Laboratory, Beaufort, North Carolina*

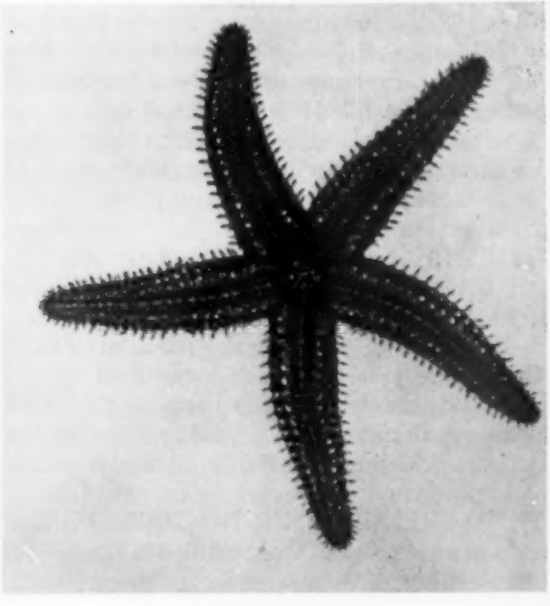
The radiographs shown with this article were taken with a 50 K.V. Picker X-Ray machine. The one feature which makes this particular machine different from the conventional x-ray unit as used in hospitals is its ability to produce soft x-rays. The window in the machine is made of beryllium which allows the passage of soft x-rays through it. The soft x-rays are selective for atomic number, thus allowing radiographs to be made of thin objects such as leaves and small invertebrates.

The radiographs which have the black background were taken directly on Kodak, F-5, enlarging paper. The radiographs of shells and other dense subjects required a voltage of 160 volts and 10 milliamperes. Thinner and less dense objects such as the starfish required 110 volts and 10 milliamperes. The exposure time varied with the specimen, but the average time was one and a half minutes.

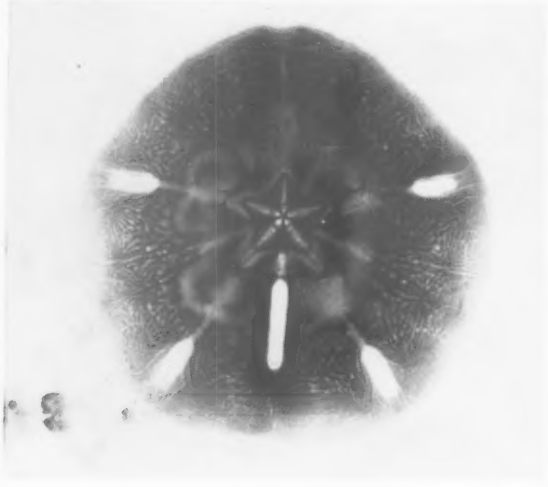




The radiographs which are on the white background were taken on sheet film and then enlarged. The voltages used with the sheet film are the same as used with the paper. The average exposure time drops to seven seconds. The negative was then enlarged using the standard enlarging techniques.



The technique as outlined above may be modified for use with a therapeutic or dental x-ray unit. The x-ray pictures which one is able to make would be useful as an extension for classroom instruction. As one can see, the spiral of the mollusk shell shows very vividly, giving the students the opportunity to see structure without the destruction of the original specimen.



BIOLOGY IN THE NEWS

BROTHER H. CHARLES, F.S.C.
St. Mary's College, Winona, Minnesota

HOW TO CAMP COLD AND STAY WARM, Gerry Cunningham and Ted Dutton, *Sports Afield*, November 1960, pp. 52-55, 94-97.

This article is of special interest for all those who want to know more about survival in the cold. It is filled with practical suggestions as to conduct as well as to what to bring along on a trip, what clothes to wear, and how to wear them.

THEY'LL NEVER TAME THE EVERGLADES, John Bird, *Saturday Evening Post*, November 5, 1960, pp. 40-41, 83-86.

The Everglades National Park offers an entirely different kind of experience to its visitors. The article describes a few of the Park's primitive beauty spots as well as a few of the dangers which attend the too venturesome.

HOW FREE IS YOUR DOCTOR, William Peters, *Redbook*, October 1960, pp. 58-61, 101-103.

A discussion of the attitudes of the American people to the medical profession in general and to the family physician in particular. This and the following reference to the more extensive article in *Harper's* will furnish ample material for extensive discussions on the subject of American medicine.

THE CRISIS IN AMERICAN MEDICINE, *Harper's*, October 1960, pp. 121-168.

This special supplement includes eight articles written by both medical men and lay authors. It is for your better students.

YOUR CHILD AND DEADLY WEAPONS, Martin L. Gross, *Redbook*, October 1960, pp. 48-49, 104-105.

Who is responsible for most of the tragic incidents involving guns? How could such tragedies be avoided? This short article could set off lively discussion on the problem.

CAN JUNIOR FOOTBALL HURT YOUR

BOY? *Good Housekeeping*, October 1960, pp. 82-83, 166-175.

Are parents justified in opposing games for pre-teenagers which involve severe bodily contact? This article gives some convincing arguments. It could stimulate some efforts to provide better means for protection in such games.

HYPNOSIS IS STILL DANGEROUS, Lester David, *Good Housekeeping*, October 1960, pp. 86-87, 175-179.

Hypnosis, as a method of treatment, is being used by an increasing number of physicians. This article discusses what good results can be expected from its use; when it can be used wisely; and the results of unwise use.

THE ALASKA BROWN BEAR, Jack O'Connor, *Outdoor Life*, October 1960, pp. 64-67, 111-115.

An interesting account of the life history, habits and antics of the Alaskan brown bear, America's most highly prized big game tophy.

STRANGE BIRDS THAT CANNOT FLY, *Life*, October 10, 1960, pp. 104-111.

A series of paintings by Guy Tudor of famous birds, most of which are still alive on some part of our globe. You will want at least two copies of these wonderful pictures for your bulletin board file.

END CHILD LABOR NOW! A. E. Farrell, *Good Housekeeping*, November 1960, pp. 62-63, 182-188.

One of the problems of migrant labor is how to provide for the healthy development of children. This article graphically describes some conditions migrant workers' children have to endure. Young thinking might aid in solving this problem.

AAAS Cooperative Committee Fall Meeting

Washington, D. C. was the site of the recent meetings of the AAAS Cooperative Committee. The following, in digest form, is a report of the procedings of the Committee.

Recent studies of the Division of Chemical Education indicate the work of chemistry instructors in small colleges produces a real effect on student's later aspirations to continue graduate-level, research work in chemistry.

The Chemical Bond Approach Committee is moving ahead in its establishment of its new chemistry approach. The program produced by the Committee will be used in 80 different high schools during this school year.

There will probably be a AAAS grant for a feasibility study in elementary science. Regional conferences of scientists and educators will probably be held. These conferences will discuss the present status of science education in elementary schools and in junior high schools. Recommendations for methods of studying the problems and initiating steps to their solution will be given.

It has been increasingly difficult for scientists and mathematicians to acquaint themselves with curriculum studies in science and mathematics. It was suggested that some agency should accept the responsibility of keeping all interested persons informed of developments in the science and mathematics curriculum studies now underway. School administrators need to be informed of the new curriculum studies. The National Council of the Teachers of Mathematics will sponsor eight regional conferences this fall to acquaint school administrators with new materials in mathematics.

The Committee recommended that AAAS take steps to plan for a Congress on Secondary Education. It also recommended that *Science Education News* be expanded in its news coverage.

A Sub-Committee of the Cooperative Committee will study professional education requirements for secondary-school science teachers.

A double-degree program in the liberal arts and in education has achieved success at the University of Minnesota.

The Committee discussed at great length numerous suggestions for ways and means of recognizing well-qualified teachers of science and mathematics. No definite plan was formulated. However further study of the problem was suggested.

The development of a traveling science film library was proposed. A committee will

study the feasibility of developing a list of films for such a library.

A lengthy discussion of Model High Schools was undertaken and proposals for same were covered. A committee will report on ways to implement this proposed development. Most of the chief state education officers seem to endorse the proposed development of Model High Schools.

A suggestion was made that the Committee develop a list of suggested courses for the training of elementary school science and mathematics teachers.

The next meeting of the Cooperative Committee is scheduled for April, 1961 in Minneapolis, Minnesota.

H. Seymour Fowler
NABT representative

Gifted Students and BSCS

Gifted students in high schools throughout the country will have a chance to participate in unlimited biological research this fall. They will be testing materials now in preparation at the University of Colorado for the gifted student in biology. A special committee is compiling the materials as part of the Biological Sciences Curriculum Study writing conference.

The finished materials probably will be in the form of 100 to 150 prospectuses or general outlines and suggested procedures in research. They are being designed to "motivate gifted students to undertake scientific endeavor while they are in high school instead of waiting until they get to college," Dr. Jerome Metzner explained.

Metzner, faculty member from Francis Lewis High School and the City College of New York, said the committee is taking research suggestions for superior students submitted by biologists, scientists, and educators throughout the country.

"The committee tentatively has decided to organize teams which will visit the schools, possibly offer advice on the use of the materials, and attempt to evaluate their efficiency," he said. Metzner said the committee plans to continue gathering materials to keep the research problems as up to date as possible.

Dr. Hubert Goodrich, Wesleyan University, Conn., said he and his colleagues are designing "possible research studies to which the answers are unknown, as apart from the 'cookbook method' where the student follows a study which has been done before." This plan, the two men said, "puts the student in the position of a real researcher instead of that of a person doing laboratory exercises." Metzner said he hoped the project would "have a salutary effect in developing talent in science and produce a harvest of scientists who can further their careers by going on with their education."

Dr. Paul Brandwein, senior editor and educational consultant for Harcourt, Brace and Co., heads the gifted student committee. With him are Metzner and Goodrich, Evelyn Morholt, Fort Hamilton High School, New York; Dr. Richard Lewontin, University of Rochester; Walter Rosen, Marquette University; and secretary, Miss Martha Sue McConnell, Manhattan, New York.

Summer Program in Botany

High school biology teachers applying for NSF summer Fellowships will be interested in the expanded offering of the summer graduate courses in botany just announced at the University of North Carolina by Professor Victor A. Greulach, Chairman, Department of Botany. Beginning in the summer of 1961, the University will offer ten graduate courses in botany in two-summer sequence, five each summer.

This program will make it possible to obtain a Master of Education degree with a major in botany in three summer sessions of twelve weeks each and to complete all course requirements for the Master of Arts in Botany degree in the same period. By working on the thesis required for the latter degree during the intervening academic years, it should be possible to complete all requirements for the MA degree in three to four years. Most of the courses offered may also be applied toward a Ph.D. in Botany but it will probably be unlikely that all requirements for this degree can be met by summer study alone.

Inquiry should be directed to Professor Greulach.

Culture of Protozoa in the Classroom*

ROBERT A. LITTLEFORD
Ward's Natural Science Establishment, Inc., Rochester, New York

Introduction

Protozoa are among the more interesting forms that may be used in the classroom at almost any level of biological study. They show such a wide variation in form and structure with so many specialized structures that they instantly attract the interest of even the most lethargic student. Their wide use in many fields of basic biological research, their growing importance as test organisms for many recent advances in vitamin metabolism, photosynthesis, and pharmacology—to name only a few areas of importance—offer many opportunities to awaken student interest in biology.

Collection of protozoa is possible from almost any conceivable habitat. Any hay infusion set up in the laboratory will yield many different types of protozoans. Mud collected from ponds, streams, and even transient bodies of water will produce forms after being kept for a short period of time in the laboratory. Plant debris, vegetation, and other materials may be collected and brought into the laboratory. The plankton protozoa may be collected by use of special collecting nets, and water may be filtered or centrifuged to obtain many minute forms.

In all of the above mentioned collections the protozoa may not become very abundant unless some additional food or nutrient material is added, and in any case, an impure culture consisting of many mixed species is obtained. A considerable amount of time is required to develop pure cultures of any desired species from such a basic culture source, and even then any pure culture will not remain in that condition for any length of time. Therefore, most instructors find that it is desirable to purchase cultures of needed species.

The purpose of the brief directions on culturing that follows is to acquaint the instructor with simple methods that can be followed in maintaining the common laboratory species for relatively long periods of time for class study. The methods presented have been picked because of their ease of operation, relatively satisfactory application to a wide range of forms, and because they are generally suited to the minimum conditions under which instructors can carry on the cultures.

General Considerations

In all of the culture methods described below certain general considerations must be kept in mind. The application of these general principles will go far to assure success with any of the proposed culture methods.

1. Temperature is a very vital factor in determining the length of life of any culture. Almost all free-living protozoa can be maintained satisfactorily over the average range of room temperatures; i.e., between 65-76° F. Specific optimum temperatures or deviations from this average are noted in specific cases. At temperatures below 53° F. growth ceases and the culture deteriorates; above 86° F. rapid destruction of the culture is evident.

2. Light is not necessary to most protozoa. This is particularly true of Paramecium (except *bursaria*) and the amoebas. These may be grown in darkness, and diffuse light is far more satisfactory than direct light. Cultures should be placed either in darkness or on the side of the room farthest away from windows. In the case of chlorophyll bearing forms such as *Paramecium bursaria*, *Volvox*, *Euglena*, and others, light from a north window is satisfactory. They should not receive direct light from windows facing other directions. In the

*A contribution from Ward's Teachers' Workshop. In September, 1959, Clarence Evaul, Science Supervisor of the Rochester City Schools, proposed a cooperative program between Ward's Natural Science Establishment and biology teachers in the high schools of Rochester, New York, and vicinity. As a result of this proposal, a schedule of regular meetings was drawn up, including lectures, demonstrations, and free discussion, permitting the exchange of ideas and experiences between persons in the scientific supply industry and those faced with the practical realities of classroom teaching. The first "Teachers' Workshop" was held in February, 1960, and covered the use of live cultures in the high school laboratory and their care and maintenance. This article is a summary of the material offered at that meeting.

absence of adequate or proper light, a light source such as a desk fluorescent lamp placed between six and eighteen inches from the cultures may be used. Only experience will determine the proper amount of light necessary for individual species.

3. The pH of the culture medium should approach neutrality. Acid conditions are to be avoided and the optimum pH should range from 7.0 to 7.6.

4. The water source is of paramount importance for success. In most areas, the use of distilled water will be found to be advantageous. Boiled pond or spring water or artificial spring water is best for cultures.

5. Sterilization of glassware and equipment is essential to avoid rapid contamination. Do not use detergents, or chemical cleaning solutions, because of possible contamination of the glassware. If possible, autoclave all glassware before use. If this is not practical, wash glassware thoroughly with a 10% solution of nitric acid, rinse with distilled water, and allow to dry in an inverted position. Glassware used should never have been in contact with formalin, fixatives, or strong chemicals. Formalin fumes in the same room will destroy most cultures.

6. Glassware used for cultures may be of various sorts and range from finger bowls through any available type of container to battery jars and gallon jugs. Finger bowls measuring 4½ inches in diameter represent a most convinent container. They are of sufficient size, easily manipulated, may be stacked to prevent contamination, and furnish a satisfactorily sized culture for most purposes. For larger cultures a one or two quart size battery jar is recommended. These may be covered with a glass plate to prevent contamination. In some special cases, erlenmeyer flacks of 250 or 500 ml. capacity are recommended.

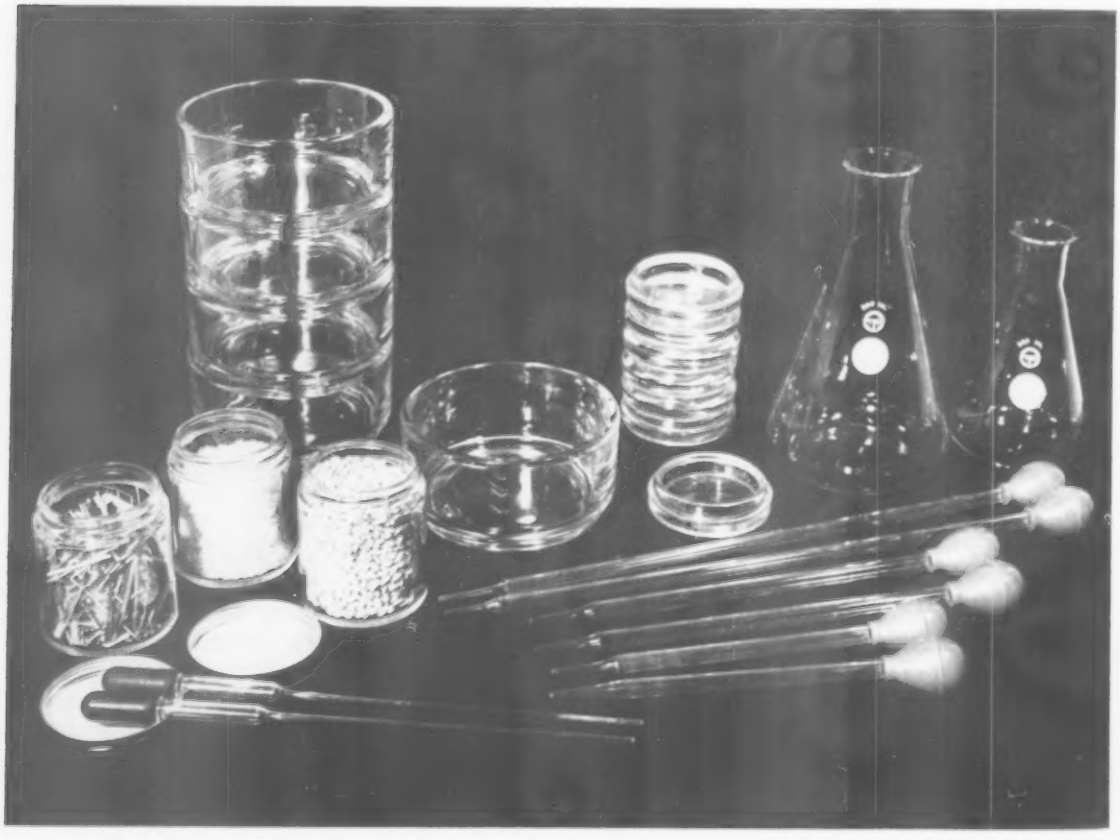


Figure 1. Materials used in culture of protozoa: finger bowls, syracuse dishes, and erlenmeyer flasks. Bottles contain timothy hay, polished rice, and wheat grains. Transfer pipettes and three sizes of pipettes are used in subculturing.

Figure 2. Finger bowl cultures stacked on shelves. Amoeba cultures on the left. Paramecium on the right. Stacking prevents entrance of dirt and contamination as well as aiding in maintaining uniform conditions.

7. In all cultures a source of food for the organism under culture must be maintained. For "impure species cultures" this may be other smaller species of protozoans such as *Chilomonas*, *Colpidium*, and in some cases *Paramecium*. In some cases, the culture media is devised so that a rapid growth of bacteria will take place. This is true of many ciliates such as *Paramecium*, *Blepharisma*, and *Spirostomum*.

Impure species cultures for our purposes may be defined as those cultures that have the desired species as the predominant form with other organisms present as food. In order to maintain this desired balance, subculturing is necessary at regular intervals, and grossly contaminated cultures must either be re-cultured or discarded.

Amoeba proteus

Amoeba is best cultured in finger bowls 4½ x 2 inches. These may be stacked and the top bowl allowed to remain empty or covered with a glass plate. Each bowl is filled with 150 ml. of distilled water and four grains of polished rice (minute rice as purchased in any grocery store) are added. Add approximately 2 ml. of *Chilomonas* from a well developed culture and inoculate with 50 *Amoeba proteus*.

At the end of two weeks, the culture should be ready for subculturing. This may be done by dividing the initial culture into a total of four bowls. Bring the volume up to 150 ml. in each bowl with distilled water and add more *Chilomonas* for food unless the growth of this species has been excessive. If subculturing is not desired, pour off half of the original solution at the end of two weeks and add fresh distilled water. Add more *Chilomonas* if necessary. Growth of mold on the rice grains is not detrimental to *Amoeba*. In heavily populated cultures, the *Amoeba* will be found around the mold on the rice. New cultures may be initiated by placing a rice grain with amoebae in a new culture dish. Examination of the culture may be made under a binocular dissecting microscope.

Another very satisfactory and universally used medium for *Amoeba* is a follows: Heat spring water to boiling and pour 200 ml. into each finger bowl while hot. Add to each 200 ml. of water 4 wheat grains that have been previously boiled for 5 minutes. When cooled to room temperature inoculate as above. Distilled water may be used in this method instead of spring water.

Chalkley's medium also serves as a widely used and more refined medium for culture of *Amoeba*. This consists of NaCL, 0.1 g.; KCL, 0.004 g.; $CaCl_2$, 0.006 g. in 1,000 ml. of distilled water. Place 200 ml. of this solution in finger bowls and add either rice or wheat grains as described above. Inoculate as given above and continue culture method.

Pelomyxa carolinensis

Pelomyxa carolinensis, often referred to as Chaos, is the largest of the amoebas and highly desirable for class study. In shipping it often tends to fragment and arrives as a large number of small amoebae. The same condition may be observed in cultures that are subject to rough handling in feeding and observation. Allowing cultures to remain relatively undisturbed for a period of three or four days will result in the individuals attaining a large size.

For proper culture of this species abundant food in the form of *Paramecium* and/or other ciliates must be available. This species should be reared in laboratory finger bowls as for *Amoeba*. Place 200 ml. of distilled water into each bowl and add 2 to 4 uncooked rice grains as for *Amoeba*. Feed daily if necessary or at least several times a week with *Paramecium* or other ciliates.

Chalkley's medium may also be used with rice grains added. Food may consist of

Chilomonas or other ciliates. A simple method that is widely used is to inoculate the *Pelomyxa* into finger bowls that contain rich cultures of *Paramecium*. Within about four weeks the *Pelomyxa* will need to be subcultured.

Pelomyxa is very susceptible to environmental conditions. A temperature of 68° F. is optimum for growth. A slight elevation of temperature to as low a figure as 72° F. generally results in deterioration of the culture. Excess concentration of organic matter or any great change in pH from 7.4 is also detrimental. Following the method outlined, using distilled water and rice grains, subcultures usually can be made every two weeks.

Other Sarcodina

Other members of the class Sarcodina that are usually cultured in the laboratory include *Arcella, Difflugia, Actinosphaerium, Actinophrys, Centropyxis*, and various amoebas and related forms that may be obtained from collection.

In all of these cases the use of laboratory finger bowls are recommended because of the reasons aforestated. In some situations the larger sized finger bowls may prove just as useful provided the depth of the fluid medium remains approximately the same as in the smaller bowls.

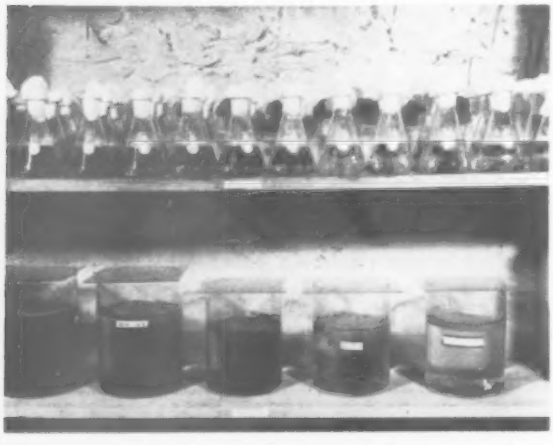


Figure 3. Top row: Cultures of *Paramecium bursaria* in 250 ml. erlenmeyer flasks. Contents of flasks are sterilized after stoppering and cooled to room temperature before inoculation. Bottom row: Series of battery jar cultures of Paramecium. These containers are ideal for typical "hay-infusion" cultures.

Arcella is commonly cultured in finger bowls having only 100 ml. of fluid medium. The shallow water level is one of the important factors in proper cultivation of either *Arcella vulgaris* or *Arcella discoides*. To 100 ml. of boiled pond water or boiled spring water add ½ gram of boiled timothy hay and two grains of boiled wheat. The timothy hay should be cut into one inch pieces and boiled for 5 minutes. Introduce *Chilomonas* as food.

Difflugia is often used as an example of the Sarcodina because of the variation in structure presented by the appearance of the shell or "test." In this genus the test is formed of cemented quartz-sand, diatoms, and other foreign bodies. Cultivation of this species is not as easy as some other forms; however, the method of Hegner usually produces satisfactory results. This method consists of shaking pond water with weeds violently and then filtering through eight thicknesses of cheesecloth. The filtrate is distributed in petri dishes, and when the suspended particles have settled, the *Difflugia* are introduced.

Another excellent method is to add one gram of fine clean sand to a finger bowl. Add spring or pond water to the finger bowl to a shallow depth, 150 ml. in a 4½ inch finger bowl. Place a considerable amount of green algae such as *Spirogyra* or *Zygnema* in the finger bowl. Usually growth will be quite satisfactory by the use of this method. Another good culture for this genus is the use of hay-wheat as described under *Arcella* or rice as described under *Amoeba*. In each case add one gram of sand to the bottom of the bowl. The sand is used by the organisms to construct the test.

Actinosphaerium and *Actinophrys* may be cultured very successfully by the use of Knop's solution. The formula is as follows:

Magnesium sulphate	0.25 g.
Calcium nitrate	1.00 g.
Potassium phosphate	0.25 g.
Potassium chloride	0.12 g.
Iron chloride (see directions below)	trace
Distilled water	1000 ml.

In mixing the solution divide the liter of distilled water into four parts of approximately 250 ml. each. Combine the solutions mixing thoroughly each time to avoid precipitation. Add the calcium nitrate last. To make the iron

chloride solution, make a 1% solution of ferric chloride fresh each time solution is used. Add one drop of this 1% solution to each liter of volume.

Another satisfactory method is to add 4 boiled wheat grains to 100 ml. of boiled pond or spring water in a culture bowl. If desirable, rice grains may be substituted for the wheat grains. In either case, as well as with Knop's solution, either of these species must be fed some other protozoan. For *Actinosphaerium*, it is recommended that *Paramecium* be used for food adding a large number of individuals as needed. For *Actinophrys*, a smaller ciliate such as *Colpidium* is desirable. Subcultures of *Actinosphaerium* should be made every two weeks, and in the case of *Actinophrys*, subcultures should be made monthly.

Centropyxis is best reared in a hay-wheat medium as recommended for *Arcella*. In some cases better results may be obtained by increasing the amount of hay to 1 g. and the number of wheat grains to 3 or 4. A slight amount of clean sand on the bottom of the bowl will also aid in the development of the test that contains fine sand grains or diatom shells.

Chilomonas

This colorless flagellate has a saprozoic form of nutrition and is widely distributed in stagnant water and hay infusions. Because of its small size, and ease of cultivation in large numbers, it is used extensively as a food organism for many other protozoans under culture. It can be obtained by bringing in water and vegetation and letting this material stand in the laboratory. This wild culture may be enriched by adding wheat grains or some other form of nutriment to the water-vegetation material.

The simplest method for culturing this species is the use of a wheat infusion made by adding 4 to 6 grains of wheat to 100 ml. of boiled pond water. Another very simple method for those who prefer the typical infusion technique is to add 10 g. of timothy hay to 1000 ml. of distilled or spring water. Boil for 10 minutes, allow to cool, and inoculate with *Chilomonas*.

Euglena

The members of this genus are widely distributed in freshwater ponds and streams that contain considerable organic debris. They may be found in abundance in stagnant pools and in the scum covering the surface of ponds. During the year they show their greatest abundance in June, July, and August. While almost all species may be cultured readily, the one usually used for classroom work is the common *Euglena gracilis*.

The simplest method for culturing *Euglena* that is applicable to many species is that given by Johansen (1940). The split pea infusion is made by boiling 40 split peas (yellow seem to give best results) in one liter of tap water. Add enough citric acid to prevent excessive bacterial growth. We have found that distilled, spring, or pond water works equally well, and in some cases, better than tap water. In addition, the citric acid is often unnecessary. Cool to room temperature and place in large clean battery jars and cover. Inoculate with *Euglena*. Keep the culture in a window sill or some other place where direct sunlight is available. This type of culture will last indefinitely if additional peas are added at monthly intervals and the water lost by evaporation or use is replaced by distilled water. Temperature requirements are not critical as *Euglena* can tolerate a wide range of temperatures. Subcultures may be made as and when needed.

Another simple method that is quite useful particularly for *Euglena gracilis* is as follows: To one gallon of boiled spring or pond water add 30 grains of boiled wheat and 30 grains of rice. Add 50 ml. of boiled and cooled skim milk. Place in battery jars and handle as above. Subculture once a month or add fresh medium every week or ten days. Normal length of life of individual cultures is approximately 3 months if fresh medium is added regularly.

Phytomonadina

The phytomonads are small, green flagellates that are more or less rounded. The vegetative cells are flagellated and usually are actively motile during the vegetative phases of the life cycle. They are closely related to the algae and are considered members of the order Volvocales by the algologist. While culture directions for these forms more properly come under a discussion of culturing algae, sufficient information is included here to enable the instructor to culture those genera such as *Chalmydomonas*, *Pandorina*, *Eudorina*, *Gonium*, and *Volvox* that are often considered

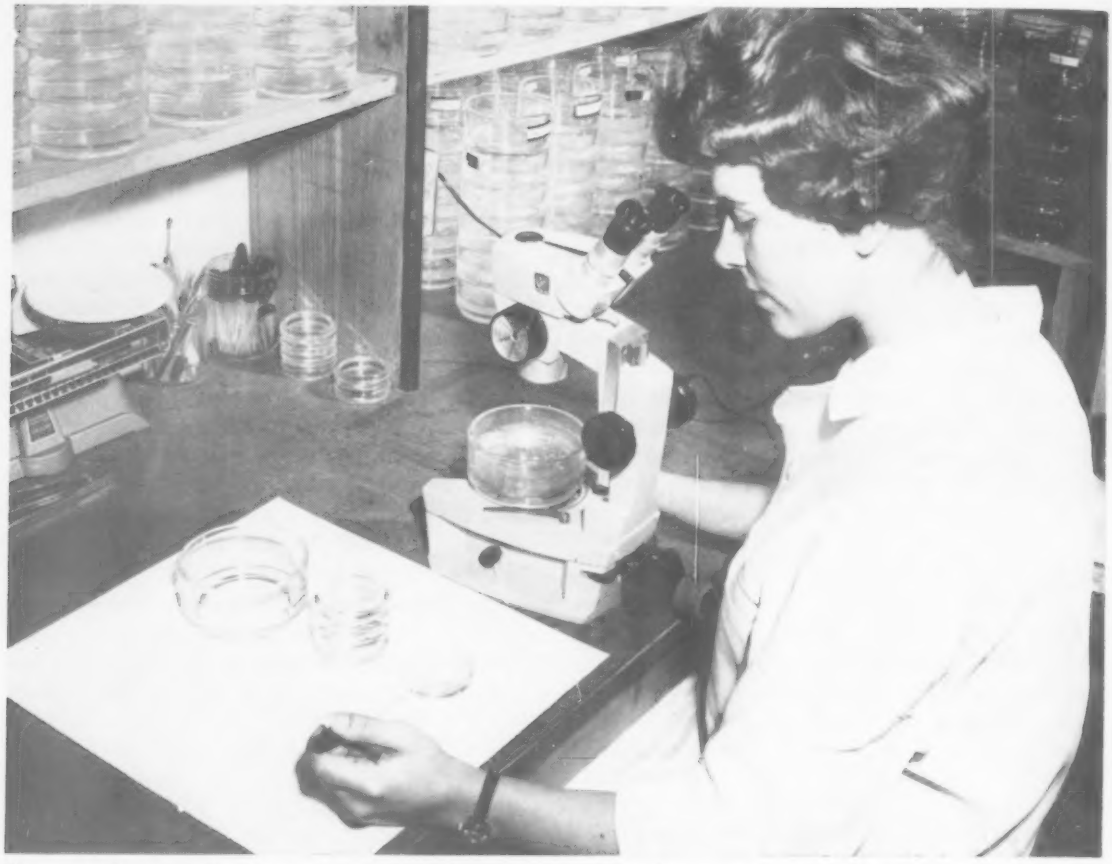


Figure 4. In subculturing, selected organisms are transferred to syracuse dishes in as small an amount of medium as possible. From these containers they are transferred to finger bowls. This method offers better control of possible contamination of cultures.

as protozoa and studied in conjunction with the more typical animal organisms.

One of the more commonly used culture mediums is made by adding 1 gram of commercial fertilizer, 4-10-4 or 5-10-5, to one liter of spring water. This material is then heated to between 80 and 90° C., filtered, and placed in culture bowls. For *Volvox*, it is best to use 0.2 g. of fishmeal and proceed as above. After filtering add 0.5 ml. of a 1% solution of ferric chloride. Place the bowls where they will receive a moderate amount of light and an even temperature.

The inorganic medium of Uspenski and Uspenskaja (1925) has been used with considerable success in the cultivation of all of these forms. The formula is as follows:

Potassium nitrate.....0.25 g.
Magnesium sulphate.....0.25 g.
Calcium nitrate.....1.00 g.
Monobasic potassium phosphate .....0.25 g.
Potassium carbonate .....0.345 g.
Ferric sulphate.....0.0125 g.
Distilled water.....1 liter

In making this solution the ferric sulphate should be sterilized separately and added to the medium after both units have been sterilized. The pH of this solution should be about 7.6 at 20° C. For use the solution has to be diluted with distilled water. In most cases a 1:9 dilution is recommended; however, other dilutions may prove more practical in individual cases. In any case, for use pour 100 ml. of the solution in flasks of 200 ml. capacity and inoculate with a few colonies of the desired species. Keep the inoculated flasks in a cool place with artificial illumination. The flasks should be plugged with cotton to avoid contamination or otherwise covered. It is essential that the flasks that are used for this work be made of

alkali-free glass as otherwise the soluble alkalies will leech out into the solution and cause considerable trouble. If glass containers of this type are not available, wash the containers thoroughly with sulphuric acid and then rinse out the acid with distilled water. The rinsing must be so effective that all of the acid is removed from the glass.

One of the best all-round nutrient solutions for growing the members of this group is Knop's modified solution. The formula is as follows:

Magnesium sulphate	0.1 g.
Potassium phosphate	0.2 g.
Potassium nitrate	1.0 g.
Calcium nitrate	0.1 g.

To prepare this solution, divide one liter of distilled water into four parts of approximately 250 ml. each. After dissolving each of the chemicals noted above in one portion of the water, combine into one volume adding the calcium nitrate last. Mix thoroughly after combining each part. To the combined solution add one drop of a 1% ferric chloride solution that has been freshly made. This solution may be used in any dilution that is most satisfactory from full strength to 1:10. The lower dilutions appear to be the most satisfactory.

As a general rule, the addition of iron to these nutrient solutions should be made every ten days in summer and once a month during the winter. Our experience has been that *Chlamydomonas* will do best either in the commercial fertilizer solution or in a 1:10 Knop's solution. *Volvox* grows very well in the solution of Uspenski and Uspenskaja and in Knop's solution. The other genera mentioned grow equally well in any of these solutions.

Paramecium

Paramecium, like most of the ciliates, are bacterial feeding protozoans. The basic requirements of a good culture medium for this species is one that will enable a sufficient quantity of bacteria to develop so as to support optimum growth of the desired population. For containers either small finger bowls or battery jars are recommended. Again it should be pointed out that cultures in finger bowls are easier to handle and can be better regulated than those in battery jars.

The most widely used culture medium is made by adding 4 to 6 grains of previously boiled wheat to 200 ml. of boiled pond or spring water. Distilled water may be substituted if desired. The use of a hay infusion made from timothy hay is one of the best and at the same time readily used methods for culturing *Paramecium*. The method consists of placing 6 g. of timothy hay cut into one inch pieces in a liter of distilled water. Boil for 20 minutes or until the water becomes brown. Allow to cool, ripen for 24 hrs., and add *Paramecium*. Modifications of this method allow the use of finger bowls or erlenmeyer flasks. In the first case, divide the solution and the hay between finger bowls; in the second case divide the material between 250 ml. capacity erlenmeyer flasks. For *Paramecium aurelia* and *Paramecium bursaria* it is best to reduce the amount of hay to 4 g. Cultures may be kept for months by adding a few pieces of hay to the culture each month.

For *Paramecium bursaria* one of the best methods is that of a lettuce infusion. This is made by taking clean leaves of lettuce and drying slowly in an oven until they are crisp and brown but not black. Burned leaves should be discarded and the rest of the material ground with a mortar and pestle. If this ground lettuce is placed in a glass-stoppered bottle it may be kept indefinitely. Place 1½ g. of the ground lettuce in 1 liter of boiling water and boil for 5 minutes. Filter while hot into 250 ml. erlenmeyer flasks. Stopper with cotton and let stand over night. If "parafilm" is used to seal the flasks they may be stored for relatively long periods of time. For use take 2 parts lettuce infusion and 1 part sterile distilled water. The addition of an excess of calcium carbonate to maintain the pH at 7.2 is often helpful. Culture in 250 ml. erlenmeyer flasks that are stoppered and placed in diffuse light. The light is necessary for the growth of the symbiotic alga that produces the green color in *Paramecium bursaria*. Instead of using lettuce, a powder known as "Cerophyl" produced by the Cerophyl Laboratories, Kansas City, Missouri, can be used very successfully. In this case add 2 g. of Cerophyl to 1 liter of distilled water and heat to boiling. Allow the solution to stand after filtering for 24 hours at room temperature. Inoculate with *Paramecium bursaria*. Culture as given above.

Demonstration of Conjugation in Paramecium bursaria

In order to demonstrate this reaction it is necessary to start with two pure-line cultures of *Paramecium bursaria*. A drop of individuals from each of the two pure-lines may be mixed in depression slides, deep-well slides, or watch glasses. The mixing of the cultures must be carried out in the light, sunlight if possible, and around noon. The reason for the choice of time lies in the fact that the mating reaction is more intense at this hour than at any other time. All pipettes used must be kept clean, and the two stock cultures must not be contaminated by each other.

Study under the binocular dissecting microscope or the low power of the compound microscope. Clumping of the cultures takes place on mixing, and the clumps become larger and larger until clumps of many individuals are formed. After six hours, the only thing that will be observed are masses of individuals. After 16 hours conjugating paramecia may be observed. The number increases so that at 24 hours numbers of conjugating pairs are present. They remain as conjugants for approximately 24 to 48 hours, after which time little, if any, conjugation may be observed.

If purchased cultures are used for this demonstration they should be used within 24 hours of delivery. Two days should be allowed for the demonstration as conjugating pairs will usually show up to best advantage on the second day. The culture dishes used for this demonstration should be kept in the sunlight or where they receive some sunlight. In order to prevent evaporation, the use of some type of moist chamber is recommended. In mixing the cultures be sure to come as close to equal proportions of the two cultures as possible and use separate dropping pipettes for each culture so as to avoid contamination.

Other Ciliates

Most other ciliates that are of interest in the school laboratory may be cultured by modifications of either the wheat or the hay infusion. In order to obtain cultures that are rich in bacterial growth and capable of supporting rapid growing populations of *Paramecium* and other forms, a common method is to place 200 ml. of distilled water into a finger bowl and add 4 grains of wheat and 12 to 15 pieces of timothy hay. Both the wheat and hay having been previously boiled as described above. This medium is ready for immediate inoculation with the desired organism.

Blepharisma, the peach colored ciliate, may be cultured in 200 ml. of distilled water to which 10 to 12 grains of wheat have been added. Subculture in 4 to 6 weeks. *Colpidium*, *Colpoda*, *Euplotes*, *Spirostomum*, *Stentor*, and *Vorticella* may all be cultured by use of the wheat medium as given for *Paramecium*. In the case of *Spirostomum* the addition *of Chilomonas* as a food organism is recommended. Also *Stentor* will grow exceptionally well in a mixed protozoan culture either in finger bowls or battery jars. It may also be cultured by feeding regularly with *Paramecium*, *Euplotes*, or *Chilomonas*.

The culture of *Didinium* can best be done by feeding this carnivorous ciliate on *Paramecium*. The *Didinium* should be cultured in fresh pond or spring water and fed *Paramecium* that have been collected from the top of battery jar cultures so as to avoid the introduction of too much culture fluid. Subculture every 2 weeks. *Didinium* quite often encysts, and the dried cultures are usable.

References

The methods for culturing protozoa are many and varied, depending upon the use one wishes to make of them and the requirements of the situation. The methods briefly outlined here are those that are relatively simple to use and easy to prepare. Following the directions carefully should enable the instructor to maintain impure species cultures for relatively long periods of time under average laboratory conditions.

For those who wish to prepare more carefully controlled cultures, or for those who need to be more specific in their requirements, the following list of references is appended.

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Nominations for Regional Directors

NABT members should vote for *one* candidate for *each* of the regions listed. Biographical background for other officer candidates may be found in the November, 1960 issue. Duties of the Regional Directors will be to represent their regions on the Board of Directors, to promote regional meetings, to initiate teacher award programs, to promote membership, to promote activities of affiliated societies, and to work actively with other scientific and educational organizations in their regions.

Region I (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont)

Dorothy T. Harlow

Present Position: Biology teacher, Rockville High School, Rockville, Connecticut.

Degrees: B.A., Smith College. M.A., University of Connecticut.

Experience: Teacher, University of Connecticut–High School Cooperative Course. Assistant General Chairman, North Connecticut Science Fair Steering Committee. Member, General Committee, National Science Fair, 1959.

NABT Activities: State Membership Chairman.

Organization Membership and Activities: Member, CSTA, CEA, and AAAS. Winner, Elizabeth Thompson Award for outstanding science teaching in New England, 1958.

Irving Keene

Present Position: Biology teacher, Weston High School, Weston, Massachusetts.

Degrees: B.S., Middleburg, College. M.Ed., Boston University.

Experience: Biology teacher in secondary schools for over 30 years. Graduate study at Harvard and Cornell. Organized first Science Fair in Massachusetts. Speaker at various meetings. Developed Plant and Wildlife Conservation Center, Brookline, Massachusetts.

NABT Activities: Local chairman, AAAS meetings in Boston, 1944 and 1950. Managing Editor, ABT, 1947-49. Regional membership chairman since 1955. Planning Committee, North Central Conference on Biology Teaching, 1955. Member, Nominating Committee, 3 years. Second Vice-President, 1958.

Organization Membership and Activities: Member, AIBS. President, New England Biological Association. Chairman, New England area, Natural Areas for School Grounds, sponsored by Nature Conservancy.

Publications: Articles in ABT.

Region II (New Jersey, New York, and Pennsylvania)

Glenn C. Ball

Present Position: Chairman, Biology Department, Carthage Central High School, Carthage, New York.

Degrees: A.B., Houghton College. M.S., University of Michigan.

Experience: High school teacher for 9 years. State sponsored science program for teachers, 1958-1959. Conducted Science In-Service Institute at State University, Potsdam, New York, 1959-1960. Research Department, St. Regis Paper Company. Recipient, NSF Summer Fellowship, Rutgers University.

NABT Activities: State Membership Chairman.

Organization Membership and Activities: Member, New York Science Teachers Association, North Central Zone Science Fair Committee, Awards Committee of Carthage High School. Secretary-Treasurer, North Central Science Teachers Association. Chairman, Carthage Central Science Fair Committee, In-Service Training Committee, and Professional Advancement Committee of Carthage High School.

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Guy T. Pinkard

Present Position: Teacher, Brentwood Schools, Brentwood, New York.
Degrees: B.S., Louisiana State University. M.S., Alabama Polytechnic Institute.
Experience: Teacher, Lutcher, Louisiana; Gonzales, Florida; Alexander City, Alabama; Lanett, Alabama; Sea Cliff, New York; and Smithtown, New York. Work toward Ed.D. degree. Assistant in science education, New York University. U. S. Air Force Chemical Warfare Service. Founder, National High School Biology Exchange Club. Research on *Coleus*.
NABT Activities: Member, State Membership Committee.
Organization Membership and Activities: Member, Phi Delta Kappa, Kappa Delta Pi, NYSTA, and SCSTA.

Region III (Illinois, Indiana, Michigan, Ohio, and Wisconsin)

Robert R. Costa

Present Position: Teacher of biology and advanced biology; Chairman Science Department; and Elementary Science Consultant, Liberty Township Schools, Youngstown, Ohio. Instructor, Youngstown University.
Degrees: B.S., Youngstown University. M.S., Iowa State University. Graduate work: Ohio State University, Wesleyan University, Western Reserve University, and University of Leeds and University of Hull, England.
Experience: Fishery biologist, State of Florida. Fulbright Exchange Teacher, Yorkshire, England. Participant, NSF Institutes. Fellowship, NSF Summer Fellowships for Secondary School Science Teachers. Member, Science Teachers Advisory Committee, Buhl Planetarium, Pittsburgh. Participant, Regional Conference of National Commission on Teacher Education and Professional Standards, 1960.
NABT Activities: State Membership Chairman for Ohio.
Organization Membership and Activities: Member, NSTA, AIBS, AAAS, Ohio Education Association, NEA, Ohio Academy of Sciences, Association of Midwestern College Biology Teachers, and American Cancer Society.

John Gundlach

Present Position: Chairman, Biology Department, Neenah High School, Neenah, Wisconsin.
Degrees: A.B., B.S., M.S., University of Wisconsin.
Experience: High school biology teacher for 25 years. Advanced Standing Program teacher for 2 years. Critic teacher, Wisconsin State College, Oshkosh, Wisconsin. Participant, NSF Summer Institute, Indiana University.
NABT Activities: State Membership Chairman for Wisconsin. Region III Membership Chairman.
Organization Membership and Activities: Member, AAAS, AIBS, ANSS, NEA, Wisconsin Education Association, Wisconsin Ornithological Society. Reviewer, AIBS Film Series. Sponsor, Biology Club.
Publications: Participant, Biological Sciences Curriculum Study Writing Conference, 1960.

Region IV (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota)

Rex Conyers

Present Position: Biology teacher and elementary science consultant, University City Public Schools, St. Louis County, Missouri.
Degrees: B.S., M.Ed., University of Missouri. Graduate work, University of Michigan.
Experience: High school teacher for 20 years. Instructor, Washington University and Harris Teachers College, St. Louis; University of Michigan. Director, Workshops in Outdoor Education, Drury College, Developed one of first large-scale conservation demonstration outdoor laboratories at Independence, Missouri. Sponsor, winners in Greater St. Louis Science Fair. Leader, workshop and project techniques in science. Instructor, adult evening school in nature recreation. Consultant, summer camps, AIBS Film Series, Indiana University elementary science film series, and in NSF institutes.
NABT Activities: Charter member. Candidate for President. State Membership Chairman. Regional Chairman, Conservation Project. Participant, North

Central Conference. Major contributor, Conservation Handbook.

Organization Membership and Activities: Member, AAAS, AIBS, NEA, NSTA. Past President, Missouri Science Teachers Association, Webster Groves Nature Study Society. Member, Board of Directors, ANSS. Secretary and Chairman, Conservation Section, CASMT. Local representative, ANSS and NABT, St. Louis Convention of AAAS; Association for Childhood Education International, Association for Supervisor and Curriculum Development. Recipient of Conservation Award of St. Louis Audubon Society Nature Center. Summer staff, National Audubon Society. Producer and moderator, weekly radio and television program in "Adventures in Nature." Consultant in audio-visual instruction, U. S. Office of Education. Director, field camps for elementary pupils, University City Schools.

Publications: "Flight Schedule of Birds of Jackson County, Missouri." Co-author, "Guide to Birding Areas of St. Louis Region," "Keys to Learning Out-of-Doors," "Key to Who's Who Among the Insects?" and "The Nature of Camp White Cloud." Assisted in revision of two biology texts. Articles in *ABT* and other journals.

Wilbur H. Rusch, Sr.

Present Position: Professor of Science, Concordia Teachers College, Seward, Nebraska.

Degrees: B.S., Illinois Institute of Technology. M.S., University of Michigan.

Experience: Taught at Concordia Junior College, Fort Wayne; Lutheran Hospital School of Nursing, Fort Wayne; Purdue University Extension Division, Fort Wayne.

NABT Activities: College Membership Chairman for Nebraska. Member, Health Education Committee.

Organization Membership and Activities: Member, NSTA and Nebraska Academy of Science. Secretary-Treasurer, Seward City Library Board. Member, Policy Committee, Nebraska Academy of Science.

Publications: "Tree Key for Great Lakes States."

Region V (Delaware, Maryland, District of Columbia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia)

Gladys B. Adams

Present Position: Assistant Professor of Biology, Tennessee Agricultural and Industrial State University, Nashville.

Degrees: B.S., M.S., Tennessee Agricultural and Industrial State University.

Experience: High school science teacher, Cook High School, Athens, Tennessee. Coordinator, Freshman Biology; Executive Secretary, Alumni Association; Coordinator, Biology Club; Advisor, *Biolog Staff;* all of Tennessee Agricultural and Industrial State University. NSF Institutes, University of Utah and Oregon State College.

NABT Activities: State College Membership Chairman.

Organization Membership and Activities: Member, AIBS, AAAS, Tennessee Academy of Science, American Camping Association, Beta Kappa Chi, AAUP.

William Foil

Present Position: Biology teacher, Hanes Senior High School, Winston-Salem, North Carolina.

Degrees: B.S., M.Ed., University of North Carolina.

Experience: Dupont Fellowship, University of North Carolina, 1954. Summer and In-Service Institutes. Participant, NSTA Regional Conference, 1960.

NABT Activities: State Membership Chairman.

Organization Membership and Activities: Member, NSTA, NEA, North Carolina Education Association, AAAS, Phi Delta Kappa. Sponsor, Key Club, Science Club, After-School Science Program.

Regions VI and VII (Arkansas, Alabama, Florida, Georgia, Louisiana, Mississippi, Arizona, New Mexico, Oklahoma, and Texas)

Clyde T. Reed

Present Position: Associate Professor of Biology, University of Tampa, Florida.

Degrees: A.B., Campbell College. M.S., Washing College. M.S., Cornell University.

Experience: Teacher in colleges since 1914. Organized, Texas Academy of Science, Texas Association of Science Teachers, Florida Association of Science Teachers, Texas Junior Academy of Science. Member, Florida Curriculum Revision Committee. State Membership Chairman, NSTA and ANSS.

NABT Activities: Regional Membership Chairman.

Professional Organizations and Activities: Fellow, AAAS. First Vice-President, ANSS. Member, AAAS Council, Hillsborough County Science Council, Florida Association of Science Teachers, Florida Education Association, NEA, AAAS, AIBS, South Eastern Biologists, National Association for Research in Science Teaching, NSTA, ANSS, Society of Systematic Zoologists, International Society of Marine Biologists, Florida Academy of Science, Texas Academy of Science, Tennessee Academy of Science, and Florida Horticultural Society, AAMP, Torch Club.

Publications: "Marine Life of Texas Waters." Editor, 3 years, *Bulletin of Florida Association of Science Teachers.* Other articles in professional journals.

Ruth B. Thomas

Present Position: Professor of Biology, Eastern New Mexico University, Portales.

Degrees: B.S., Northwestern College of Louisiana. M.A., Peabody College. Ph.D., Vanderbilt University.

Experience: Taught in public schools of Louisiana, Millikin University, Peabody College, Sullivan College.

NABT Activities: State Membership Chairman of New Mexico.

Organization Membership and Activities: Fellow, AAAS. Vice-Chairman, Botanical Section, Rocky Mountain Southwestern Division of AAAS. Member, New Mexico Academy of Science, Botanical Society of America, AIBS, AAUP, Delta Kappa Gamma, Altrusa, Sigma Xi. Involved in Science Fair Activities.

Publications: "Reproduction in *Pinus virginiana.*"

Region VIII (Colorado, Idaho, Montana, Nevada, Utah, and Wyoming)

Stanley B. Mulaik

Present Position: Associate Professor of Zoology, University of Utah, Salt Lake City.

Degrees: B.S., State Teachers College, Pennsylvania. M.S., Cornell University. Ph.D., University of Utah.

Experience: Grade school and high school teacher in Pennsylvania. Consultant, instructor, and director for nature study in camps in Pennsylvania, New Hampshire, and Texas. National staff of Girl Scouts as nature study director. Consulting specialist, Dugway Ecological Laboratory. Associate Director, NSF Summer Institute, University of Utah. Research grants (NSF).

NABT Activities: Consultant, NABT North Central States Biology Teachers Conference, 1955. State membership chairman, Utah. Member, Conservation Committee.

Organization Membership and Activities: President, South Texas Science Teachers Association. Editor, Newsletter, ANSS. Vice-President, Conservation Education Association. Member, NARST, Sigma Xi, Utah Academy of Science, Wilderness Society, Soil Conservation Society of America, State General Science Curriculum Committee, NSTA, State Conservation Education Council, Biological Society of Washington, Entomology Society of Washington, AAUP, Nature Conservancy, Society of Systematic Zoologists. Fellow, AAAS, Texas Academy of Science. Member, Natural Resources Council of America. Past President, Western Section ANSS. President, ANSS, Utah Nature Study Society.

Publications: 35 papers in zoology.

Region IX (Alaska, California, Oregon, Washington, Hawaii, and Puerto Rico)

John V. Bruce

Present Position: Biology and physiology teacher, San Ramon High School, Danville, California.

Degrees: B.S., M.S., Utah State University, Logan.

Experience: Biology field work, U. S. Fish and Wildlife Service. Biology teacher in Wyoming and California. Director, Junior Mu-

seum. Teaching assistant in zoology and entomology, Utah State University. Participant, NSF Institutes, University of Utah, University of California, and University of Minnesota.

NABT Activities: State Membership Chairman for California.

Organization Membership and Activities: Sigma Xi and California Teachers Association.

Publications: Rodent Control Bulletins, Utah Extension Service.

Irene Hollenbeck

Present Position: Professor of Science, Southern Oregon College, Ashland.

Degrees: B.S., University of Oregon. M.S., Oregon State College. Ed.D., University of Colorado.

Experience: High school biology teacher for 20 years. College teacher of botany and biology for 7 years. Experimental studies in problems of teaching superior and retarded high school biology students and school camping for elementary school children Ford Foundation Fellowship, 1953-54. NSTA Outstanding Teacher Award, 1952.

NABT Activities: Past President. Chairman, State Committee on Outdoor Education. Regional Membership Chairman. Charter member.

Organization Membership and Activities: Member, NSTA, NARST, Oregon Academy of Science, Phi Beta Kappa, Phi Kappa Phi, Kappa Delta Pi. Fellow, AAAS.

Publications: Co-author, "Selected Procedures for Teaching Biology." Articles in *ABT*, *Science Education*, *The Science Teacher*, and *Selected Science Teaching Ideas of 1952*.

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Proposed Revisions of the Constitution of NABT

The following changes have been proposed in the Constitution by the Executive Board, and these changes are noted below with the statement of the original Constitution wording by its side. The Constitution requires that all such changes be published in the journal prior to action of the Board of Directors.

As Now Stated:

Article IV, Section 5, Board of Directors.

The Board of Directors shall consist of the Executive Board of the Association, members of the editorial board, members of the advisory board, all past presidents, one or more delegates, based on membership, from each affiliated local association, chairmen of all permanent and standing committees, regional chairmen, and members at large elected by the Board of Directors.

Proposed Amendment:

Article IV, Section 5, Board of Directors.

The Board of Directors shall consist of the Executive Board of the Association, Regional Directors, members of the Editorial Board, members of the Advisory Board, all Past Presidents, one or more delegates, based on membership, from each affiliated local association, chairmen of all permanent and standing committees, Regional Membership Chairmen, and members-at-large elected by the Board of Directors.

As Now Stated:

Article IV, Section 7, Regional Chairmen.

These chairmen shall be recommended by the Executive Board and approved by the Board of Directors. The number and term of office shall be decided by the Executive Board. Such chairmen shall assist the Executive Board in organizing state committees, holding regional conferences and meetings, and in promoting membership in the Association.

Proposed Amendment:

Article IV, Section 7, Regional Directors.

Regional Directors shall be elected annually for two-year terms upon nomination by the Nominating Committee. Directors elected for the first year shall have terms of one or two years at the discretion of the Executive Board. The regions which each Director shall represent shall be identical to the regions recommended by the Third Vice-President for membership solicitation work. Each Director shall work with the Regional Membership Chairmen in promoting membership in the Association. These two offices may be held by the same individual. Additional duties of the Regional Directors shall be to promote local and regional meetings, to promote the activities of affiliated organizations, to work with other scientific organizations in his region, to set up an organization for the establishment of regional "Outstanding Biology Teacher Awards," and to appoint appropriate committees to carry out these functions.

By-Laws

As Now Stated:

Article II, Section 1.

A nominating committee of five classroom teachers, that are members in good standing in the Association shall be appointed by the Executive Board. This committee shall make nominations for offices of President Elect, First Vice-President, Second Vice-President, Third Vice-President, Secretary-Treasurer, and Recording Secretary, in conformance with Section 4 of this Article.